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THE COMPARATIVE RESISTANCE OF WHEAT VARIETIES TO SPROUTING IN THE STOOK AND WINDROW[1]

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On the plains of Western Canada the average annual loss from the effects of weather on the unthreshed grain runs into millions of dollars. A large part of this loss is caused by the sprouting of grain in the stook and windrow. The practice of curing the grain in the stook and windrow and leaving it thus exposed until such time as an itinerant threshing outfit can take care of it is very general in this region. Much of the grain remains in the field more or less unprotected for fully a month. Prolonged wet spells during September or October are almost sure to bleach the exposed grain and cause a large amount of it to sprout. Sprouted grain has distinctly less value for seed purposes or for milling than undamaged grain, consequently resistance to after-harvest sprouting is an important advantage in a cereal variety.

This is particularly true with respect to wheat varieties since the wheat of Western Canada is grown largely for export trade and must be of high uniform quality if it is to command a satisfactory price. It is only recently that public attention has been drawn to the extent of the losses from after-harvest sprouting and to the fact that leading varieties of wheat may differ markedly in their propensity toward sprouting.

The prairies of western Canada are a dry farming area but a period of a week or more of wet weather weather not infrequently occurs toward the end of the harvest season. This is particularly true in the more northern farming districts. During the past five years there have been three seasons, 1927, 1930 and 1931, in which a prolonged period of wet weather in September and October did immense harm to stooked and windrowed grain.

On October 10, 1927, toward the end of a ten day period of moist weather, the writer observed that the amount of sprouting in stooks of the various standard varieties of wheat differed markedly, as shown in figure 1. It was therefore decided to obtain comparative samples for an accurate determination of the extent of sprouting in different varieties. In September, 1931, when a similar period of wet weather occurred a further study was made.

PROCEDURE

In 1927 from September 30th to October 10th the weather was moist. There was a little rain every day and very little drying occurred owing

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Figure 1. Heads of Reward (1), Garnet (2), Marquis (3) and Ruby (4), from stooks exposed to ten days of wet weather in the fall. These heads were taken from comparable positions about two feet from the ground on the east side of the stooks. The heads projected out from the sheaves and were not touching adjacent heads. In the case of Garnet and Ruby, many kernels had long sprouts and well advanced primary roots.

to the high humidity, low temperature, general cloudiness and low wind velocity. Just previously, the weather had been almost ideal for harvesting and threshing operations. The ten day wet period compared with the preceding ten day period was on the average 3.5°F. cooler, 12.5 per cent more humid, with distinctly more precipitation, only a quarter as much sunshine and less than half a smuch wind velocity.

At the end of the wet period samples were taken from each stook in a quadruplicate one-fortieth acre plot test of standard spring wheat varieties. The stooks were of average size, each containing all of the

sheaves from one plot. Examination showed that most of the exposed grain was discolored by weathering and a fair amount of it was sprouted. The sprouting on the east side of the stocks was much worse than on the other sides. The sampling was done by taking a random lot of twelve spikes from the east side of each stook at about two feet above the ground level.

After samples were collected, they were immediately taken into the laboratory. The seeds of each sample were then removed from the spikes with forceps and divided into four classes on the basis of sprout length. The classes were as follows: (1) long sprouts, the roots and plumule being vigorously developed and the latter at least three-fourths of an inch long; (2) mid-long sprouts, the roots and plumule being moderately developed with the latter more than a third, but less than three-fourths of an inch long; (3) short sprouts, the roots and plumule being only slightly developed and the latter not over a third of an inch long; (4) no visible sprouts, the seed being swelled and somewhat soft but the bran not broken.

In 1931 from September 11th to 23rd, the weather was very similar to that of the wet period in the fall of 1927 excepting that there was more rain. The twelve day wet period compared with the five previous and five following days was on the average 7.5°F. cooler, 15.6 per cent more humid, with considerably more precipitation, less than a third as much sunshine and only half as much wind velocity.

On September 23rd samples were taken from loose piles of harvested grain in a five times replicated series of plots of the four leading wheat varieties of Saskatchewan. The piles of grain were small and consisted of plants cut off three or four inches from the ground. Adjacent standing grain protected the piles from the full drying effect of the wind. Sprouting was more general in this material than in some stooks not far away. It was estimated that ordinary windrowd grain would have averaged somewhat lower in the amount of sprouting than these loose semi-protected piles. Therefore, when samples were taken any heads within an inch or less of the ground or in a depressed place in the pile were avoided. Otherwise in a random manner, a sample of approximately twenty spikes were taken from each pile. The laboratory work on the samples was accomplished in the same way as in 1927.

In order to have a check on the accuracy of the sampling in the 1927 work, samples of Marquis, Sask., 70 were taken from eight plots instead of from only four as for the other varieties. Table 1 gives the results. The percentage of unsprouted seeds was practically the same in one set as in the other. Fisher's test for goodness of fit was applied to the totals; χ^2 was 0.315 and P between .90 and .80. This showed that the two sets of data were closely similar and demonstrated that four samples of each variety was a sufficient number for reliable results.

Results

The 1927 Study: The complete data from the 1927 study are presented in table 2. The varieties ranged from Garnet, which showed extreme susceptibility to sprouting, with only 7 per cent nonsprouted

TABLE 1.—*Accuracy of the sampling as shown by a comparison of the results from two sets of replicated check plots of the 1927 Marquis.*

Variety	Replicate	Distribution of kernals according to degree of sprouting				Total number kernels examined	Mean in terms of class values
		Long sprouts 1*	Mid-Long sprouts 2	Short sprouts 3	No visible sprouts 4		
Marquis 70	1	0	2	3	196	201	
	2	0	1	5	172	178	
	3	0	20	9	210	239	
	4	0	0	1	223	224	
Totals		0	23	18	801	842	3.92
Marquis 70	1	0	2	5	236	243	
	2	0	7	7	179	193	
	3	0	0	23	225	248	
	4	0	0	2	186	188	
Totals		0	9	37	826	872	3.94

*Class value in terms of resistance to sprouting.

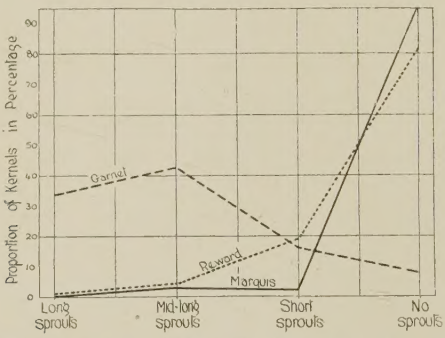

Figure 2. Comparative sprouting of Marquis, Reward and Garnet wheat after exposure in the stook to ten days of wet weather in the fall of 1927.

seeds, to Marquis, which showed extreme resistance to sprouting, with 95 per cent nonsprouted seeds. None of the other varieties were as low as Garnet in proportion of unsprouted seeds, although Ruby had only 28 per cent and Quality only 29 per cent. Only one variety closely approached Marquis in percentage of unsprouted seeds, and that was Kitchener, with 93 per cent. Reward was reasonably high, with 76 per cent of unsprouted kernels.

The χ^2 Goodness of Fit test applied to all of the 1927 results gave a total χ^2 of 749.0 and a P value considerably less than .001. The odds are very great that there are significant differences between varieties. The χ^2 test was then applied to the data for various pairs of varieties. The results are shown in table 3. Marquis was not significantly more resistant to sprouting than Kitchener and Red Fife, but compared with other varieties was distinctly superior. The odds were very high that Marquis resisted sprouting better than Reward, Renfrew, Garnet and all the remaining varieties. There were high odds also that Reward sprouted much less readily than Garnet. The 1927 results for Marquis, Reward and Garnet are shown graphically in figure 2.

TABLE 2.—*Comparative results on thirteen wheat varieties for resistance to sprouting in the stook following ten days of wet weather in September, 1927.*

Variety	Replicate	Distribution of kernals according to degree of sprouting				Total number kernels examined	Mean in terms of class values
		Long sprouts 1*	Mid-long sprouts 2	Short sprouts 3	No visible sprouts 4		
Marquis 70	1	0	2	3	196	201	
	2	0	1	5	172	178	
	3	0	20	9	210	239	
	4	0	0	1	223	224	
Totals		0	23	18	801	842	3.92
Percentage values		*0.00*	*2.73*	*2.14*	*95.13*	*100*	
Reward	1	1	7	27	165	200	
	2	0	5	30	153	188	
	3	5	6	55	69	135	
	4	1	8	37	198	244	
Totals		7	26	149	585	767	3.71
Percentage values		*.91*	*3.39*	*19.43*	*76.27*	*100*	
Garnet	1	69	79	40	17	205	
	2	98	94	15	8	215	
	3	46	96	20	12	174	
	4	79	96	62	26	263	
Totals		292	365	137	63	857	1.96
Percentage values		*34.07*	*42.59*	*15.99*	*7.35*	*100*	
Red Bobs	1	0	2	41	157	200	
	2	0	26	46	152	224	
	3	6	19	25	175	225	
	4	1	12	19	295	327	
Totals		7	59	131	779	976	3.72
Percentage values		*.72*	*6.05*	*13.42*	*79.81*	*100*	
Ruby	1	43	81	30	48	202	
	2	0	88	48	85	221	
	3	23	92	43	45	203	
	4	32	103	82	75	292	
Totals		98	364	203	253	918	2.66
Percentage values		*10.68*	*39.65*	*22.11*	*27.56*	*100*	
Quality	1	32	39	71	62	204	
	2	0	41	86	79	206	
	3	0	44	88	41	173	
	4	15	70	91	49	225	
Totals		47	194	336	231	808	2.93
Percentage values		*5.82*	*24.01*	*41.58*	*28.58*	*100*	
Red Fife	1	0	9	14	161	184	
	2	0	7	20	171	198	
	3	3	10	11	194	218	
	4	0	12	26	163	201	
Totals		3	38	71	689	801	3.81
Percentage values		*.37*	*4.74*	*8.87*	*86.02*	*100*	

*Class value in terms of resistance to sprouting.

TABLE 2.—*Continued*

Variety	Replicate	Distribution of kernals according to degree of sprouting				Total number kernels examined	Mean in terms of class values
		Long sprouts 1*	Mid-long sprouts 2	Short sprouts 3	No visible sprouts 4		
Kitchener	1	0	1	4	198	203	
	2	0	4	6	180	190	
	3	0	0	11	212	223	
	4	0	9	22	213	244	
Totals		0	14	43	803	860	3.92
Percentage values		*0*	*1.63*	*5.00*	*93.37*	*100*	
Early Red Fife	1	6	30	31	127	194	
	2	2	18	51	82	153	
	3	10	30	79	110	229	
	4	18	54	47	79	198	
Totals		36	132	208	398	774	3.25
Percentage values		*4.65*	*17.05*	*26.88*	*51.42*	*100*	
Mindum	1	0	1	120	110	231	
	2	0	0	58	148	206	
	3	0	0	143	96	239	
	4	0	2	66	191	259	
Totals		0	3	387	545	935	3.58
Percentage values		*0*	*.32*	*41.39*	*58.29*	*100*	
Marquis 7	1	0	0	32	160	192	
	2	0	2	17	176	195	
	3	5	18	43	189	255	
	4	0	7	43	291	341	
Totals		5	27	135	816	983	3.79
Percentage values		*.51*	*2.75*	*13.73*	*83.01*	*100*	
Renfrew	1	0	3	57	115	175	
	2	1	22	20	183	226	
	3	0	11	34	158	203	
	4	0	21	41	184	246	
Totals		1	57	152	640	850	3.68
Percentage values		*.12*	*6.71*	*17.88*	*75.29*	*100*	
Kubanka	1	0	6	80	140	226	
	2	0	1	108	101	210	
	3	0	3	129	135	267	
	4	0	5	137	109	251	
Totals		0	15	454	485	954	3.49
Percentage values		*0*	*1.57*	*47.59*	*50.84*	*100*	
Peliss	1	1	1	39	135	176	
	2	0	2	73	133	208	
	3	0	0	84	137	221	
	4	0	0	98	175	273	
Totals		1	3	294	580	878	3.67
Percentage values		*.11*	*.34*	*33.49*	*66.06*	*100*	

*Class value in terms of resistance to sprouting.

TABLE 3.—*The χ^2 test applied to the 1927 data from various pairs of varieties.*

Variety pairs	χ^2	P	Odds that the first named variety excels in resistance to sprouting
Marquis 70 and Kitchener	0.17	.93	None
" " Red Fife	5.50	.15	7 to 1
Marquis 70 and Marquis 7	9.81	.02	50 to 1
" " Red Bobs	10.85	.01	100 to 1
" " Reward	16.08	Less than .01	Very high
" " Renfrew	16.48	" " .01	Very high
" " Garnet	158.16	" " .001	Enormous
Reward and Renfrew	1.79	.65	None
" " Pelissier	7.61	.05	20 to 1
" " Garnet	121.99	Less than .001	Enormous

TABLE 4.—*Comparative results on the four leading wheat varieties of Saskatchewan for resistance to sprouting in the windrow following twelve days of wet weather in September, 1931.*

Variety	Replicate	Distribution of kernals according to degree of sprouting				Total number kernels examined	Mean in terms of class values
		Long sprouts 1*	Mid-long sprouts 2	Short sprouts 3	No visible sprouts 4		
Marquis	1	26	23	67	84	200	
	2	20	18	65	96	199	
	3	18	22	71	89	200	
	4	23	14	90	73	200	
	5	11	13	84	92	200	
Totals		98	90	377	434	999	3.15
Percentage values		*9.8*	*9.0*	*37.7*	*43.5*	*100*	
Reward	1	31	40	73	55	199	
	2	13	25	91	64	193	
	3	20	74	37	68	199	
	4	2	7	72	119	200	
	5	5	15	113	67	200	
Totals		71	161	386	373	991	3.07
Percentage values		*7.16*	*16.20*	*38.95*	*37.64*	*100*	
Ceres	1	55	52	53	40	200	
	2	46	31	53	68	198	
	3	50	71	46	33	200	
	4	62	59	64	15	200	
	5	10	11	38	144	203	
Totals		223	224	254	300	1001	2.63
Percentage values		*22.27*	*22.38*	*25.38*	*29.97*	*100*	
Garnet	1	109	59	27	4	199	
	2	151	37	12	1	201	
	3	130	66	5	0	201	
	4	113	40	47	2	202	
	5	88	38	49	26	201	
Totals		591	240	140	33	1004	1.62
Percentage values		*58.87*	*23.90*	*13.94*	*3.29*	*100*	

The 1931 Study: Table 6 gives the results of the 1931 study. The relative placing of Marquis, Reward and Garnet is the same as in 1927. Marquis showed the highest resistance to sprouting with 44 per cent of unsprouted kernels, Reward came next with 38 per cent, Ceres had 30 per cent, and Garnet only 3 per cent.

Application of the χ^2 test to the 1931 data showed that it, like the 1927 results, involved significant varietal differences. The value of χ^2 was 124.4 and P was less than .001. The χ^2 was then applied to the data for the various pairs of varieties. The results are shown in table 5. Marquis and Reward were not significantly different with respect to sprouting, although Marquis showed the advantage. The odds were very high, however, that both of these varieties excelled Ceres and Garnet in sprouting resistance. Ceres in turn greatly excelled Garnet. Figure 3 shows the 1931 results graphically.

TABLE 5.—*The χ^2 test applied to the 1931 data from various pairs of varieties.*

Variety Pairs	χ^2	P	Odds that the first named variety excels in resistance to sprouting
Marquis and Reward	2.93	.40	2.5 to 1
" " Ceres	15.43	less than .01	Very high
" " Garnet	87.23	" " .001	Enormous
Reward and Ceres	12.47	" " .01	Very high
" " Garnet	82.61	" " .001	Enormous
Ceres " Garnet	41.29	" " .01	Very high

A brief summary of the results on the leading varieties tested in the two studies is contained in table 6. Whether the results are viewed from the standpoint of percentage of unsprouted kernels or are compared by means of the χ^2 Goodness of Fit test they show Marquis at the top for sprouting resistance and Garnet at the bottom. It is of particular interest that, although the percentage of unsprouted kernels was far higher in the 1931 material than in the 1927 samples, the relative positions of the varieties in terms of sprouting resistance did not change appreciably. Garnet had 7.73 per cent as many unsprouted kernels as Marquis in 1927, and 7.57 per cent as many in 1931. For Reward the comparative figures are 80.17 per cent and 86.65 per cent.

TABLE 6.—*Summary of 1927 and 1931 results on leading wheat varieties for resistance to sprouting in the field after harvest.*

Variety	Percentage of kernals that did not sprout		Resistance to sprouting in percentage of Marquis	
	1927	1931	1927	1931
Marquis	95.13	43.44	100.00	100.00
Reward	76.27	37.64	80.17	86.65
Garnet	7.35	3.29	7.73	7.57
Ceres		29.97		68.99

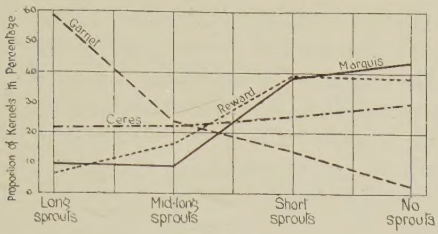

Figure 3. Comparative sprouting of Marquis, Reward, Garnet and Ceres wheat after exposure in piles on the ground to twelve days of wet weather in the fall of 1931.

Discussion

It is only during recent years that people have realized how markedly the well known cereal varieties may differ in their propensity toward sprouting when in the swath or stook. The continuous repetition of the assertion that Saskatchewan is a dry farming area has tended to obscure the fact that long periods of wet weather may occur toward the end of the harvest season. Until recently there was no great wheat acreage in northern and eastern Saskatchewan, and it is there that the weather is often unfavorable for the quick drying of harvested grain. The varieties that occupied the bulk of Saskatchewan's wheat acreage up to 1927 were reasonably resistant to after-harvest sprouting. At least none of them sprouted easily.

Since 1927 the situation has changed radically. It was in 1927 that Garnet, on account of its extreme earliness and high yield, commenced to spread rapidly through the northern and eastern farming districts of Saskatchewan. In that year Marquis occupied about 90 per cent of the wheat acreage of the province, and the other 10 per cent consisted chiefly of Red Bobs strains, Red Fife, Kitchener, Early Red Fife and durums. The 1927 investigation on sprouting showed that Marquis was excellent for sprouting resistance. Kitchener equalled Marquis in this respect, and Red Bobs, Red Fife, Reward, Renfrew and Pelissier were good. Mindum and Kubanka were less resistant. Early Red Fife proved still less desirable. Quality sprouted fairly easily, Ruby more easily, and Garnet very easily. Fortunately Early Red Fife has never been popular in the north and east, on account of its lateness and its extreme susceptibility to rust. Neither have Ruby and Quality been popular in these areas on account of low yield in the first instance, and white seed in the second. But Garnet has quickly come to occupy an extremely large acreage in those parts. The 1931 investigation was limited to the four leading varieties. Here again Marquis and Reward proved highly resistant in comparison with Garnet, which, as in 1927, sprouted badly. Ceres proved somewhat less resistant than Reward.

In 1931 the three leading wheat varieties of northern and eastern Saskatchewan were Marquis, Garnet and Reward. The present investigation has shown that after-harvest sprouting may occur in all of these varieties, the amount varying according to the weather, the conditions of the grain as to exposure, and the variety. Ten day periods of wet weather in September and October proved very conducive to sprouting.

The amount of sprouting was greatest where there was the best chance for moisture to penetrate, and the least opportunity for drying to take place. Well capped, upright stooks showed very little sprouting, except within the capping sheaf and within exposed parts of the sheaves on the east side. Wherever a sheaf had been blown onto the ground or partly settled down into a position approaching the horizontal, or wherever rain or snow had been blown well into the stook, a great deal of sprouting occurred. The difference, however, between varieties was the most striking. Under similar conditions conducive to sprouting Garnet sprouted rapidly and thoroughly, whereas Marquis and Reward sprouted slowly and to a relatively small extent. Spikes of Garnet that stuck out from the tops of bundles and were fully two inches from the nearest other heads were found to be more than 50 per cent sprouted in many cases. The only other instance of this was found in Ruby.

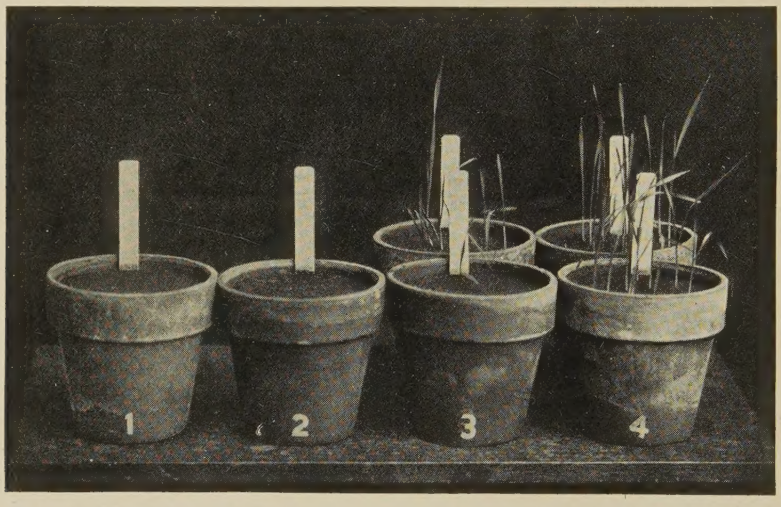

Figure 4. Results from sowing seeds from the wheat exposed to prolonged wet weather in the stook during early October. Kernels with long sprouts were sown in Pot 1, with mid-long sprouts in Pot 2, with short-sprouts in Pot 3 and with no visible sprouts in Pot 4. The front row of pots was sown with Garnet and the back row with Marquis.

In 1930 and 1931 examinations of swathed grain were made on various farms of northern Saskatchewan following the extended wet periods that occurred in September, and in most cases Garnet was found to be sprouted much worse than Marquis or Reward. It is important, however, to note that disastrous sprouting of swathed grain was also found in both Reward and Marquis. From this it seems evident that the practice of leaving swathed grain exposed to wet weather is a dangerous one. Every possible means should be used to avoid this, as the chances for the occurrence of prolonged wet weather in September are great.

After-harvest sprouting of wheat is decidedly detrimental to its value whether the grain is to be used as seed or for milling. A small proportion of sprouted seed lowers the commercial value of wheat one or two grades. This is the most serious loss a farmer faces when sprouting occurs in the

stook, windrow, or stack. Probably his second greatest loss is in the value of the grain for seed. To illustrate this, representative lots of seed of the four different "sprout length" classes were sown in the greenhouse in pots. The results are shown in figure 4. It is clear that sprouted grain should not be used as seed.

In conclusion, it is apparent from the results of this study that every feasible means should be used to avoid loss from sprouting after harvest. Since varieties differ greatly in their resistance to sprouting, the farmer should carefully weigh the value of this character along with that of other important characters such as yield, earliness, and quality when he is deciding which variety to grow. If he decides to use a variety with low resistance to sprouting, he should plan his acreage and harvesting and curing methods in such a way as to have the greatest possible protection against loss from sprouting. The institutional breeder should keep sprouting resistance in mind as one of the more important characters necessary to have in any new variety, particularly in one that is to be used in the park belt region of the prairies. The farm machinery manufacturer also has a distinct responsibility; the harvesting machinery should be built in such a way that losses due to after-harvest sprouting of grain are reduced to a minimum. A distinct advance in this connection is some of the recent machinery for making proper header barge stacks. It does not take much sprouted wheat to lower the grade considerably and in three years of the past five, there has been sufficiently wet weather toward the end of the harvest season to cause millions of dollars of loss through discoloration, swelling and sprouting of exposed wheat.

Summary

1. In 1927 the weather following harvesting was wet from September 30th to October 10th and comparable samples of grain were taken from the stooks of a quadruplicate plot test of Marquis, Garnet, Reward and ten other varieties. The samples were analysed by dividing the kernels of each into four classes on the basis of the amount of sprouting.

2. In 1931 a similar wet period lasted from September 11th to 22nd and a study of samples was undertaken as in 1927 excepting that the material had been exposed to the weather in semi-protected piles in a five times replicated plot test of Marquis, Garnet, Reward and Ceres.

3. The amount of sprouting was widely different in the varieties tested, Marquis sprouting the least and Garnet the most. The amount of sprouting was greater in the 1931 material than in the 1927 samples but the relative positions of the varieties were the same.

4. Compared with Marquis, Reward had 80.2 per cent as many unsprouted kernels in 1927 and 86.7 per cent as many in 1931; on the other hand Garnet had only 7.7 per cent as many in 1927 and 7.6 per cent in 1931. Roughly Marquis resisted sprouting thirteen times as well, and Reward about nine times as well as Garnet. Ceres fell between Garnet and Reward, though much closer to Reward, in sprouting resistance.

RESULTS OF A SEVEN YEAR PLUM THINNING EXPERIMENT[1]

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In the spring of 1923 following the exceptionally heavy crop of 1922 the loss through winter injury to plum trees in the Niagara District of Ontario was severe. One outstanding observation was that the better care the orchard had received in 1922 and previously, and therefore the better the vigor of the tree, the less the winter injury. There was also strong evidence to indicate that the winter injury bore a direct relationship to the size of the 1922 crop: the heavier the crop, the greater the winter injury. This difference was especially marked in the tenderer varieties. In many of the latter, trees were killed outright whereas in some of the hardier kinds no injury resulted regardless of the previous crop.

Judging from these observations there seemed a possibility that thinning, by preventing devitalization due to overbearing, would maintain the vigor of the tree, and thus render it less susceptible to winter injury.

It was also observed that the well cared for trees again had a good crop in 1923 which suggested the possibility that thinning would not only maintain the vigor of the tree but that annual bearing might also be established and maintained by thinning.

METHODS

With this in mind a plum thinning experiment was planned in the Station orchard where there were seven Domestica varieties of twelve trees each planted in adjoining rows. These trees were set out in 1908 with approximately one replant (1910) in each variety (only 1908 planted trees were included in this experiment). The soil in this orchard is a relatively uniform heavy clay loam on which the plum seems to thrive, and in this case the trees were all vigorous healthy fifteen year old specimens which had received uniform orchard treatment until the time when the thinning experiment was started except that one tree each of Reine Claude, Gueii, Duane and Lombard was left unthinned as a demonstration in 1922. Previously all trees were thinned regularly.

The varieties included in the experiment were Reine Claude, Gueii, Duane, Pond, Washington, Lombard and Yellow Egg. Four trees of each variety were left unthinned as a check and the remaining seven (or eight) were thinned every year there was a sufficient crop to warrant thinning. In thinning, sufficient plums were removed so that as far as possible no two plums would be touching at maturity. In most cases the whole tree had to be thinned, while in others, particularly in the "off" years, only certain branches required thinning. The time of thinning was immediate-

[1]Read before the Horticultural Group at the eleventh annual convention of the Canadian Society of Technical Agriculturists at the Ontario Agricultural College, Guelph, June 23rd, 1931.

[2]Assistant in Hardy Fruit work.

ly following the June drop or slightly before it was complete. The unthinned or check trees were distributed throughout the plots so as to minimize soil differences as much as possible. Probable errors on yield and size of fruit were determined by the use of Bessel's formula.

Literature

In Fruit Growing by Chandler (*1*) there is a complete summary of the literature up to 1925 on the effect of thinning upon fruit and tree, and Waring (*2*) in the 1928 Report of the American Society of Horticultural Science reporting on "Fruiting and Growth in the Lombard Plum: Some Effects of Thinning" brings this literature up to that date.

Experimental Results

At the end of seven years thinning, 1923-29 inclusive, there was no substantial evidence that any of the varieties had acquired tendencies towards annual bearing. When the yield for every tree was plotted one or two trees had a suggestion of annual bearing. One in particular was a tree which had never borne a large crop during the thinning period and therefore showed no crop peaks. When the average yields per tree for each treatment were plotted (figure 1) there were no indications, except possibly in Gueii, of any tendency towards annual bearing.

Total yields as a whole have not been significantly altered by thinning. Reine Claude shows a gain of 3.8 times probable error or odds of 112 to 1 for thinning due largely to the fact that the heavy crops so devitalized the unthinned trees that they showed severe injury with a resultant loss of yield.

Duane had a slight but not significant gain in favor of thinning, while Washington is the only variety to show appreciable gains in yield from unthinned trees, 2.3 times the probable error or odds of 8 to 1. These latter figures are interesting because they are contrary to what was expected from this variety as the unthinned trees had been assuming a ragged appearance due to winter injury, but as the last three crops were

Table 1.—*Gain of thinned over unthinned trees in yield.*

Variety	Total Average Yield in Lbs.		Gain	Odds
	Thinned	Unthinned		
Reine Claude	703	505	225 ± 59	112 to 1
Duane	965.5	939.25	26.25 ± 164.8	Less than 1 to 1

Table 2.—*Gain of unthinned over thinned trees in yield.*

Variety	Total Average Yield in Lbs.		Gain	Odds
	Unthinned	Thinned		
Gueii	616	463	153 ± 149.7	1 to 1
Ponds	623	545	78 ± 100.2	Less than 1 to 1
Washington	896	608	188 ± 78.6	8 to 1
Lombard	591	457	134 ± 115.9	1 to 1
Yellow Egg	829	819	10 ± 57.1	Less than 1 to 1

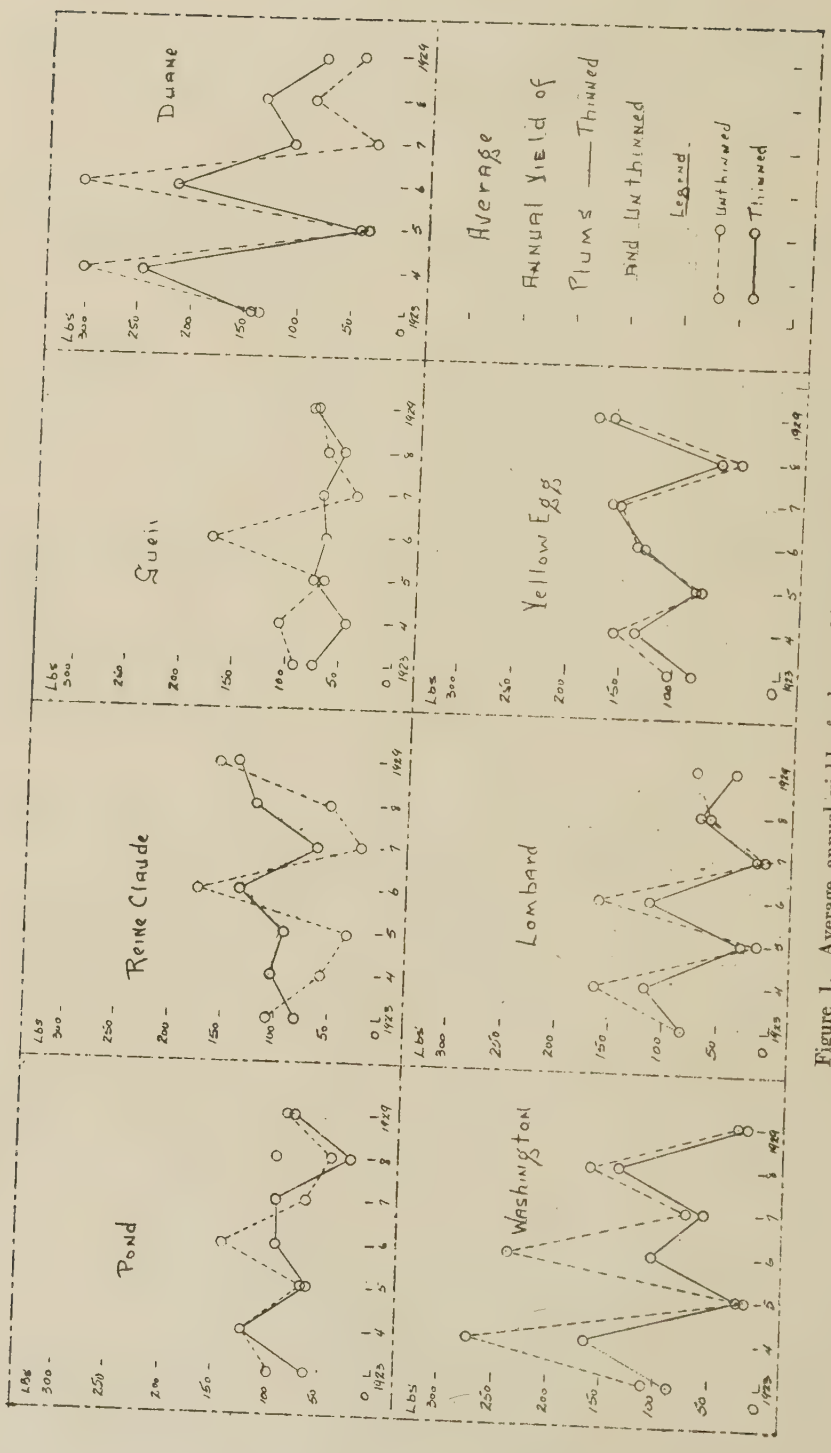

Figure 1. Average annual yield of plums, thinned and unthinned.

not excessive the trees had an opportunity to recuperate and as they have such a large bearing area they are therefore capable of producing tremendous crops in their "on" year.

To offset this loss in yield, thinning gave an appreciable increase in the size of fruit which was therefore of greater commercial value.

Size of fruit was obtained by taking the average count of two 11-qt. baskets, equally full of fruit, from each tree in the experiment. This was done for the first four years of the experiment 1923-26 inclusive. While the increase in size is appreciable in every case it is not always statistically significant (odds 30 to 1) owing to the high probable error as the result of the variability in size of the unthinned fruits and the small number of trees (4) left unthinned. (Uniformity in size of fruit is a recognized reason for thinning and one can therefore readily appreciate this variability in size of the unthinned fruits).

Thinned fruits within a variety are quite uniform in size but from unthinned trees with the "on" and "off" years the size becomes very variable and increases the probable error to such a degree that striking differences are not statistically significant. For example, the average number of plums per basket per year from the seven (thinned) Gueii trees was as follows: 318, 297, 286, 276, 274, 291, 268, or a grand average of 286 $\pm$ 9.5 plums per basket. The averages from unthinned trees were 507, 408, 425, 358, or a grand average of 425 $\pm$ 45.8 plums per basket. Gueii is a small plum and while 286 plums per basket would be of fair size for the variety, 425 plums per basket would be too small to have market value: yet, due to the high probable error of the average yield of unthinned trees, which is a result of factors already mentioned, the probable error of the difference ($\pm \sqrt{9.5^2 - 45.8^2} = \pm 46.7$) is so large that the odds that thinned fruits are larger than unthinned fruits are only 22 to 1 which are not considered significant.

The effect of thinning in increasing size of fruit is therefore amply borne out in the following table if one takes the average size of fruit into consideration rather than the odds alone. It should be noted that as the size of the plums increase the fewer there are in the basket, and the less proportionately is the waste, i.e., pits etc. The different varieties have different optimum sizes.

TABLE 3.—*Increase in size of fruit from thinning.*

Variety	Average number of plums per 11-qt. basket		Gain in size indicated by decreased number in basket	Odds
	Unthinned	Thinned		
Reine Claude	473	365	108 $\pm$ 29.2	99 to 1
Gueii	425	286	139 $\pm$ 46.7	22 to 1
Duane	325	259	66 $\pm$ 21.2	26 to 1
Ponds	250	199	51 $\pm$ 14.6	57 to 1
Washington	257	209	48 $\pm$ 23.8	9 to 2
Lombard	541	339	202 $\pm$ 36.2	over 1350 to 1
Yellow Egg	254	199	55 $\pm$ 21.7	10 to 1

Thinning of these varieties of plums has resulted in no tendency towards annual yield; total crop, unless overbearing due to lack of thinning has resulted in serious injury to the trees, has not been increased but the quality of the fruit as indicated by size has been improved.

Other advantages which have been observed from time to time during the seven year period are as follows:

(1) Overbearing reduced the vigor of plum trees, and following heavy crops winter injury was very common in the more tender varieties. Thinning would seem to be justified for this reason alone on certain varieties, particularly those of the Gage group.

(2) Brown rot has been reduced. In thinning, the plums were thinned sufficiently so that as far as possible at maturity no two fruits were touching. This therefore prevents fruit clusters and the spread of rot from contact. An indication of this is shown in the following table of adjoining trees.

TABLE 4.—*The Value of thinning in reducing brown rot.*

	Good Fruit	Rotten Fruit
Reine Claude Tree 10 Thinned	108 lbs.	15 lbs.
" " " 11 Unthinned	144 "	45 "
" " " 12 Thinned	122 "	5 "
" " " 13 Thinned	140 "	10 "

Tree 10 had the lightest crop and considerable rot but not as much in proportion as tree 11, whereas trees 12 and 13 have relatively little rot. These were all picked at the same time and as will be seen later the lighter crop on tree 10 would be more mature which probable explains the increased amount of rot present.

(3) Heavy yields delay maturity and also cause delay in blooming the following spring.

In 1923 two Duane trees were not picked until five days after the remainder of the variety, because of immaturity. Each of these trees had 150 pounds of fruit whereas the other Duane trees varied from 50 to 130 lbs. per tree. Other varieties have borne out the evidence that difference in yield has an influence on time of maturity. Heavy crops tend to delay maturity, and conversely light crops have a tendency to advance the date of maturity. Differences in degrees of maturity of apples according to crop is mentioned by Palmer (*3*).

TABLE 5.—*Difference in maturity as influenced by size of crop 1923.*

Variety	Row	Tree	Yield	Date Mature
Bradshaw	17	3	12	Aug. 27
"	17	4	32	" 30
Saunders	12	5	40	" 21
"	12	6	63	" 23

The delay in blooming was very apparent in 1923 when the trees left unthinned in 1922 for demonstration came into bloom later than the remainder of the trees of their respective varieties.

			1st Bloom	Full Bloom	Falling Bloom
Reine Claude	Unthinned	1922	May 23	May 26	May 29
" "	Thinned	1922	May 18	May 24	May 26

The unthinned Duane tree was one day later in blooming than the other trees of that variety, while the unthinned Lombard tree was two days later coming into "first" bloom than were the remaining Lombard trees.

Conclusions

1. Contrary to expectations thinning has given no indications of inducing annual bearing in Domestica plums.

2. Total yield was not materially influenced by thinning, except where overbearing devitalized the unthinned trees and winter injury followed, resulting in a proportionate reduction of crop.

3. Thinning increased the size of the fruit and made the thinned product of greater economic value than that from unthinned trees.

4. Thinning assisted materially in preventing the spread of brown rot in plums.

5. Heavy yields delayed maturity, and following a heavy crop the bloom the following spring was also retarded.

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INHERITANCE OF RATE OF GROWTH IN DOMESTIC FOWL

1. Methods and Preliminary Report on Results Obtained with Two Breeds.

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The theoretical and practical importance of the problem of growth has been generally recognized. As a result the subject has received considerable attention and many theories have been advanced to explain the phenomenon of growth. However, all theories that have been proposed are as yet a matter of controversy. This is especially true of growth as measured by increase in body weight. With regard to the factors determining rate of increase in body weight (rate of growth), it is acknowledged that both heredity and environment exert an influence. Much direct evidence is available showing the influence of environment, particularly with respect to kind and amount of food, but the evidence for the influence of heredity is less satisfactory.

Undoubtedly, the complexity of the problem is partly responsible for the slow progress made in studying the genetic basis for differences in rate of growth. Moreover, many of the mathematical formulae used to express rate of growth have required so much labour to compute that curves have been employed instead to show differences in growth. Such curves cannot be compared, except by observation; hence, they are not satisfactory for analyzing the hereditary basis of growth. For this purpose it is necessary to have a reasonably simple formula that will express mathematically the rate of growth of each individual. The necessary formulae are available, but have not been used to study the particular problem of the inheritance of rate of growth, except by Robb (*17*), who applied them to the mean rates of growth of two breeds of rabbits and their hybrids, and by Waters (*22*), who compared the percentage growth rates of the Light Brahma and the White Leghorn breeds of fowl as well as their F_1's and F_2's. The available formulae are briefly reviewed in this paper and a preliminary analysis of genetic differences in rate of growth for two breeds of domestic fowl presented.

Rate of Growth

Much ground has been covered on the hereditary aspects of the rate of growth but few attempts have, as yet, been made to formulate any laws of transmission of the ability to grow. One reason for this is the difficulty of maintaining uniform environment for all individuals under test. The great variability in growth rates, even within supposedly homozygous strains, substantiates this statement.

Castle and his associates (*4, 5, 6*), Detlefsen (*7*), Macdowell (*14*) and Robb (*17*), studied the inheritance of rate of growth in mamals; May (*15*), Warren (*21*) and Waters (*22*) in domestic fowl. Rats, rabbits and guinea-pigs, which were used by the first group of investigators, are not entirely satisfactory for such study. Different litters are raised under different

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environmental conditions; hence, comparison of the various generations on an individual basis is not always justified. Poultry, on the other hand, is much better suited for the study of inherent differences in physiological characteristics. A large number of individuals can be hatched on the same day and raised under the same brooder, thus providing very similar, if not identical, environment.

The above workers, with the exception of Robb and Waters used individual growth curves in an attempt to interpret the results obtained. This method, however, makes it difficult to compare the different individuals on a Mendelian basis. Rate of growth is primarily a "size character," and, as such, can be represented numerically. By reducing the growth curve to an index number, as a common basis for the expression of all such curves, a method that would most adequately serve the purpose is provided. Robb used Crozier's autocatalytic equation on growth data on rabbits. However, he applied it to the means of the parental and F_1 generations instead of to individuals. While this method indicates inheritance of growth rate, it does not necessarily show Mendelian segregation, as Robb suggests. Waters applied the compound interest formula to the averages of Brahmas, Leghorns and their F_1's and F_2's. He observed heterosis in the first, second and, in some cases, third month of growth.

Brody (*2*) evaluated some genetic growth constants for several species of animals past the point of inflection of the growth curve, that is, for what he terms the self-inhibiting period of growth. These constants, however, are specific rather than individual, and represent the rate of approach to senescence, and not the velocity of growth from birth to maturity. Consequently they cannot be used to determine genetic differences in the ability to grow.

There are two distinct types of formulae for evaluating rates of growth, one, chiefly empirical, where the equation is fitted to the data collected; the other based in each calculation on the weight of each individual at two or more periods of time.

The first type used by Mitchell, Card and Hamilton (*16*) in their growth study cannot be used to compare the growth rates of two groups of individuals between the same age limits, since the rate of each group will have been calculated by a different formula, thus rendering statistical analysis impossible. There are also a number of objections to the second type of formula, mainly that certain laws of growth have to be assumed and certain factors influencing rate of growth, particularly differential growth of organs, neglected.

Regardless of any objection to their use for other purposes, the second type of formula is the most suitable for the present study. Their adequacy or inadequacy in meeting certain theoretical requirements of a formula for evaluating rates of growth need not be considered. What is important is that they provide a method of reducing genetically different groups and individuals to a common basis. The arbitrary figures so obtained are comparable and, hence, satisfactory for the study of hereditary differences in rate of growth.

The choice of a particular formula of this type should necessarily be based (outside of accuracy) on simplicity of computation, since a large number of individual calculations must be made.

Minot's formula for percentage rate of growth,

$$R = \frac{100\ (W_2 - W_1)}{W_1}$$

where W_1=original weight and W_2=final weight, while simple to compute, does not take into account instantaneous compoundings taking place in a natural growth process. The equations of Robertson, Pearl and Reed (Brody, *3*) and Crozier, (Robb, *17*) do not have this defect but are too cumbersome to work with.

On the other hand the continuous compound interest formula (Brody *3*),

$$R = 100\ (\log_n W_2 - \log_n W_1)$$

as well as that of Schmalhausen (*18*),

$$R = \frac{\log_n W_2 - \log_n W_1}{.4343\ (t_2 - t_1)}$$

while not necessarily expressing the true growth processes (Gray, *8*) serve as a satisfactory basis for genetic investigation. When the period of time is expressed as a unit, the former, differing from the latter only in a constant, may be adopted as the simpler one.

A further simplification may be effected by using a modified formula of Minot (Brody,*3*),

$$R = \frac{(W_2 - W_1)\ 100}{\frac{1}{2}\ (W_2 + W_1)}$$

which partly corrects the error of Minot's original formula and also comes very close, in terms of actual figures, to the above logarithmic equation of Brody. For the present study this formula has been adopted and in further discussion the term "rate of growth" or "rate" will refer to the average percentage rate of growth obtained by this method.

Experimental

Stock. In the spring of 1929 a Light Sussex male was mated to Ancona females. The F_1 chicks were weighed at hatch and every week until 12 weeks of age. The next year similar observations were taken on Light Sussex and Ancona chicks, the progeny of the F_1 and of all the possible backcross matings. All the chicks were hatched on the same day and reared under one brooder thus assuring, as nearly as possible, identical environment. A standard ration used at the University of British Columbia was fed to the chicks.

Wet mash, intended to encourage growth, was fed after 9 weeks to the chicks raised in the second brooding season, i.e., all but the F_1 chicks received it. Thus, while the F_1 generation is not strictly comparable, the F_2 and back-crosses can be safely compared to the parental races.

Data on Rate of Growth. Satisfactory growth was obtained for both males and females. While no comparable figures are available on the growth of the Light Sussex and Ancona, the data may be compared with similar observations on Barred Plymouth Rocks in the case of the Light Sussex, and White Leghorns in the case of the Anconas. Table 1 presents such a comparison of the data obtained here with the data of other investigators. (Kempster, *11*). It shows that both the Light Sussex and the Anconas exceed the weights of the corresponding breeds at 3, 8 and 12 weeks of age.

TABLE 1.—*Data on weights of chicks compared with those obtained by other investigators.*

Source of data	Breed	Weight in grams					
		3 weeks		8 weeks		12 weeks	
		♂	♀	♂	♀	♂	♀
Buckner et al	S.C.W. Leghorns	151	148	581	536	927	851
Our data	Anconas	159	150	653	583	1125	975
Kempster et al	B. P. Rocks	126	121	460	429	956	702
Our data	L. Sussex	162	143	726	527	1434	1048

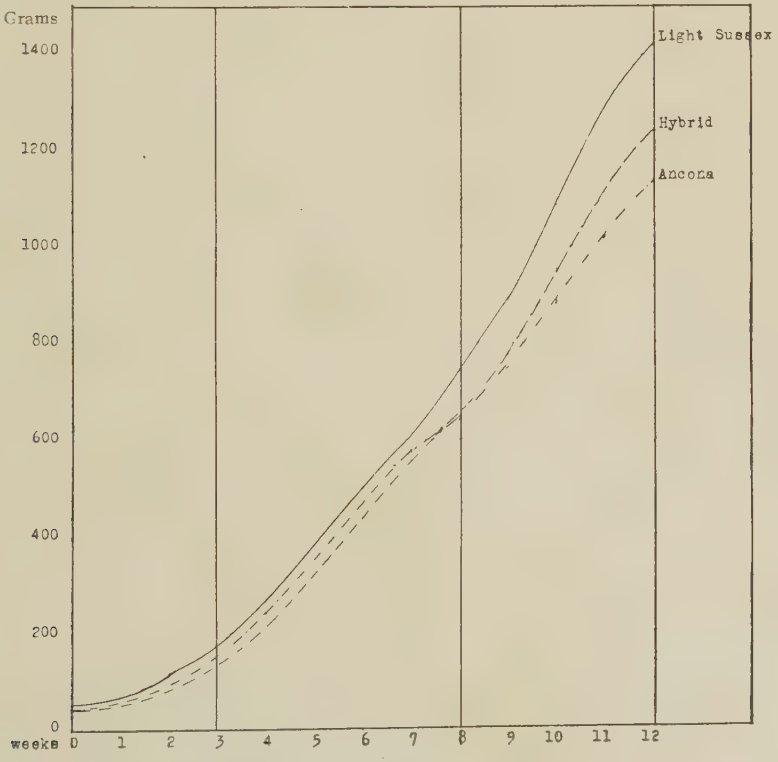

Figure 1. Comparison of average growth of males.

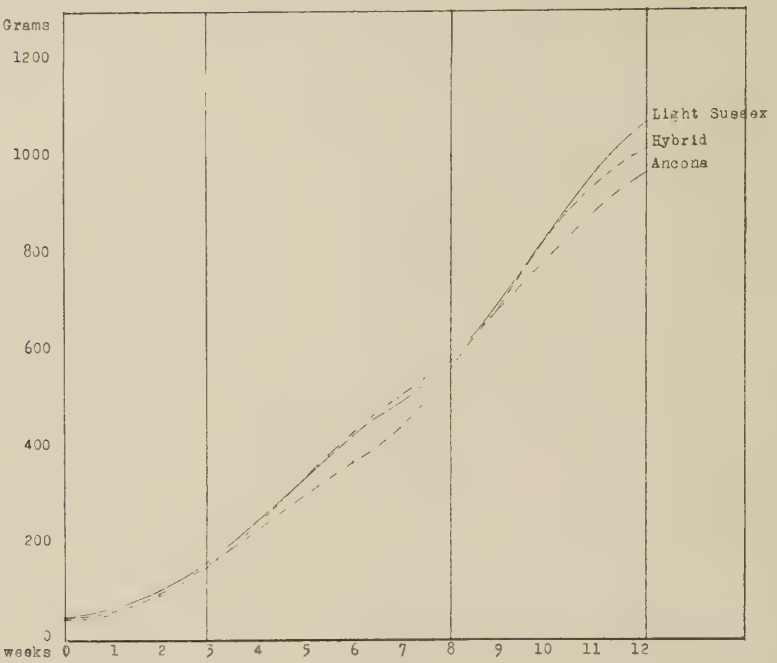

Figure 2. Comparison of average growth of females.

The data on growth for the males of the parental races and of the F_1 generation are presented graphically in figure 1. It may be seen that up to 7 weeks of age the Ancona and the Light Sussex curves run concurrently. In the case of the males a sharp separation takes place at this stage. In the case of the females (figure 2) the average weight of the Light Sussex does not differ materially from that of the Anconas until after the 9th week. At 12 weeks the Light Sussex were significantly heavier than the Anconas.

The weights of the F_1 generation from the cross Ancona $\times$ Light Sussex were equal to or slightly below those of both parental races until about the eighth week. At 12 weeks the hybrids were intermediate in weight. These results differ from those reported by May, by Warren and by Waters who found that hybrids between light and heavy breeds of domestic fowl equal or exceed the weights attained by the heavier parent. Since strictly comparable data on the parental races (Ancona and Light Sussex) and the F_1 were not obtained and the numbers are small no conclusion can be drawn at this time. It is of interest to note, however, that our results are similar to those obtained by Castle and others with mammals.

As stated above, the rate of growth was computed by Minot's modified formula. The computations were based on two periods, one from 3 to 12 weeks, the other from 8 to 12 weeks. The first interval was used in preference to the total period of observation to eliminate the influence that may possibly be exercised by the weight of the egg (and the hatching weight of the chick) on the growth rate during the first two or three

weeks. Thus while Benjamin (*1*) found that the weight of a day old chick was closely correlated with the weight of the egg from which it was hatched, the subsequent correlation was much lower and, in some cases, nil. Furthermore Upp (*20*) failed to find any correlation between weight of chicks at 2 weeks or older and the weight of the eggs from which they were hatched. A further reason for using this interval is that there appears to be a break in the growth curve at 3 weeks. The second period (from 8 to 12 weeks) is that of the greatest divergency in the growth rates of the Anconas and Light Sussex as shown in figures 1 and 2.

The use of these two periods is not in any way connected with theories of growth cycles (Brody, *3*, Gray, *8*). They are used simply as a means of measuring differences in the two breeds concerned. This may be done regardless of whether these two periods coincide with particular growth cycles or whether growth is considered a non-cyclic phenomenon.

The mean growth rates and standard deviations from the mean growth rates of the parental races and the crosses are presented in table 2. The Light Sussex show, in each case, a higher growth rate than the Anconas. The differences between these two breeds are as follows:

	MALES	FEMALES
3 – 12 week period	13.11 ± 0.97	5.07 ± 1.93
8 – 12 " "	16.10 ± 1.87	15.50 ± 1.73

These differences are statistically significant except in the case of the females for the 3 to 12 week period.

TABLE 2.—*Rates of growth.*

Description	Sex	From 3 to 12 weeks			From 8 to 12 weeks		
		No.	Mean	Standard Deviation	No.	Mean	Standard Deviation
Light Sussex	♂	4	160.95 ± 1.31	2.60 ± 0.68	4	68.75 ± 0.37	1.09 ± 0.26
Ancona	♂	5	147.85 ± 1.45	4.80 ± 1.02	5	52.65 ± 1.83	6.40 ± 1.32
F1	♂	15	160.25 ± 0.56	3.19 ± 0.33	15	64.45 ± 0.89	5.10 ± 0.63
F2	♂	9	156.45 ± 1.31	5.84 ± 0.93	8	59.95 ± 1.51	6.35 ± 1.14
F1 x L. Sussex	♂	12	160.35 ± 0.98	5.20 ± 0.69	9	59.10 ± 1.29	5.75 ± 0.91
F1 x Ancona	♂	2	157.95 ± 2.40	5.00 ± 1.69	2	61.45 ± 1.44	3.00 ± 1.01
Light Sussex	♀	5	151.35 ± 1.18	3.92 ± 0.84	5	67.45 ± 1.34	4.45 ± 0.95
Ancona	♀	3	146.28 ± 1.60	4.11 ± 1.10	3	51.95 ± 1.10	2.82 ± 0.78
F1	♀	10	154.55 ± 1.01	4.73 ± 0.71	9	53.00 ± 0.64	2.85 ± 0.45
F2	♀	16	154.45 ± 0.48	2.86 ± 0.34	16	58.08 ± 0.87	5.29 ± 0.61
F1 x L. Sussex	♀	8	154.32 ± 1.68	7.05 ± 1.19	7	61.75 ± 1.26	4.95 ± 0.89
F1 x Ancona	♀	7	149.10 ± 1.03	3.75 ± 0.74	6	50.95 ± 1.00	3.80 ± 0.71

The data on the crosses are difficult to interpret, possibly due to the small numbers and the consequent grouping together of birds from reciprocal crosses. In the case of the males the F_1 generation shows a higher mean growth rate than the F_2 generation and is less variable, but some of the differences are not statistically significant. The backcrosses (males) cannot be compared on account of the small number from the mating of F_1 to Ancona. The results for the males while not conclusive, show dominance of the more rapid rate of growth of the Light Sussex and point to

segregation of factors for rate of growth in the F_2 and backcross generations.

The results for the F_1 and F_2 generation females do not agree with those obtained for the males since the growth rates are equal or even lower for the F_1 and the variability is not significantly different. The backcrosses lend support to the data for the males which indicate that rapid rate of growth is dominant over slow rate. It is of interest to note that the growth rate of the males is higher than that of the females in all cases except one (F_1 × Light Sussex – 8 to 12 weeks), although the differences are not all significant.

In an attempt to analyze still further the inheritance of rate of growth, the data were grouped into tables 3 and 3A. It will be seen from the tables that the growth rates of the Light Sussex exceed those of the Anconas and that the two do not overlap except in the case of the females for the 3 to 12 week period. In order to classify the birds as rapid or slow growing, arbitrary figures were chosen which were between the parental values except for the females for the 3 to 12 weeks period where no division could be made. The limits are indicated by horizontal lines.

The results for the crosses are not clearcut, indicating that the mode of inheritance is too complex to fit into a simple scheme. The data in tables 2, 3 and 3A, indicate, however, that the rapid rate of the Light Sussex is dominant over the slower rate of the Ancona. Segregation of growth factors is also indicated in the F_2 generation and the backcrosses. The data for the females are more difficult to interpret than those for the males but sufficient information is not available to explain the differences in the sexes.

While the available data, due to small numbers, are not adequate for a precise genetic analysis they point fairly definitely to inherent differences in the rate of growth of the two breeds used. Furthermore, it is apparent that individual growth curves can be reduced to arbitrary figures for genetic studies. In order that such studies may succeed it will be necessary to know more about variability in growth rates within the breeds and to determine the most suitable periods to use. The material for a study of these problems, involving a number of breeds, is now available.

Body Weight at 12 weeks and Length of Tarso-metatarsus. In studies on genetic differences in rate of growth it is of interest to determine whether total weight is closely related to the length of the bones and whether there is any relation between size at any one age and rate of growth. The first is particularly important since Latimer (*12*), Huxley (*9*) and others noted differential rate of growth of different organs and parts of the body. The second problem has a bearing on the relationship of final body weight and rate of growth (Kaufman, *10*). Data, having a bearing on these problems, are available for 43 pullets (not used above) comprising 2 Anconas, 1 Ancona × Light Sussex hybrid, 12 backcrosses on Ancona, 10 back-crosses on Light Sussex and 18 F_2s from Light Sussex × Ancona. These birds were weighed at 12 weeks of age, killed on the following day and the tarso-metatarsus severed from the tibio-tarsus. The tarso-metatarsus of each bird was then prepared by the method described by Schneider and Dunn (*19*) and the length measured with calipers sensitive to 0.5 mm.

TABLE 3.—*Frequency distributions. Rate of growth.*

Class Range	3 - 12 week period											
	MALES						FEMALES					
	Light Sussex	Ancona	F1	F2	F1 x L.S.	F1 x Anc.	Light Sussex	Ancona	F1	F2	F1 x L.S.	F1 x Anc.
141.1 - 143.0		1						1				
143.1 - 145.0		1									1	1
145.1 - 147.0				1				1				
147.1 - 149.0		1					2		2		1	2
149.1 - 151.0					1				1	2	2	
151.1 - 153.0				1			1	1	1	4		2
153.1 - 155.0		2		1		1	1		1	2		
155.1 - 157.0			2	1	2				1	5		
157.1 - 159.0	1		3		1		1		1	3	1	1
159.1 - 161.0	1		3	4	1				2		1	
161.1 - 163.0			3		2				1		1	
163.1 - 165.0	2		2	1	2	1					1	1
165.1 - 167.0			2		2							
167.1 - 169.0					1							
Total	4	5	15	9	12	2	5	3	10	16	8	7

TABLE 3A.—*Frequency distributions. Rate of growth.*

Class Range	8 - 12 week period											
	MALES						FEMALES					
	Light Sussex	Ancona	F1	F2	F1 x L.S.	F1 x Anc.	Light Sussex	Ancona	F1	F2	F1 x L.S.	F1 x Anc.
42.1 - 44.0		1										
44.1 - 46.0				1								
46.1 - 48.0					1			1	1	1		1
48.1 - 50.0		1						1		1		1
50.1 - 52.0									1	1		2
52.1 - 54.0		1			1				5	1		1
54.1 - 56.0			2					1	1	1	1	
56.1 - 58.0					1	1				4		1
58.1 - 60.0		2	1	1	1					2	1	
60.1 - 62.0			1	2			1			2	3	
62.1 - 64.0			3	3	2		1		1			
64.1 - 66.0			2		1	1				1		
66.1 - 68.0	2		1	1	1		1			2	2	
68.1 - 70.0	1		2				1					
70.1 - 72.0	1		1									
72.1 - 74.0			2		1							
74.1 - 76.0							1					
Total	4	5	15	8	9	2	5	3	9	16	7	6

TABLE 4.

Description	Group No.	No. of birds	Length of Tarso-metatarsus at 12 weeks		Weight of bird at 12 weeks		Rate of Growth 8 - 12 weeks period	
			Mean	Coefficient of Variation	Mean	Coefficient of Variation	Mean	Coefficient of Variation
			cms.		gms.		percent	
All pullets	1	43	7.22 ± 0.05	6.42 ± 0.45	1097.00 ± 15.27	13.53 ± 1.06	56.90 ± 0.92	15.69 ± 1.12
F_1 x Ancona	2	12	7.01 ± 0.09	6.05 ± 0.84	1008.80 ± 19.42	9.88 ± 1.33	53.22 ± 1.00	9.65 ± 1.30
F_1 x Light Sussex	3	10	7.51 ± 0.07	4.47 ± 0.58	1240.50 ± 21.17	8.01 ± 1.03	60.05 ± 0.95	7.49 ± 0.97
F_2	4	18	7.22 ± 0.09	7.95 ± 0.89	1106.10 ± 23.36	13.28 ± 1.02	58.50 ± 1.52	16.28 ± 1.03
Difference Groups 2 and 3			0.50 ± 0.11	1.58 ± 1.02	231.70 ± 28.73	1.87 ± 1.68	6.83 ± 1.04	2.16 ± 1.62
Difference Groups 3 and 4			0.29 ± 0.11	3.48 ± 1.06	134.40 ± 31.52	5.27 ± 1.45	1.56 ± 1.79	8.79 ± 1.41
Difference Groups 2 and 4			0.21 ± 0.12	1.90 ± 1.22	97.30 ± 30.38	3.40 ± 1.68	5.28 ± 1.82	6.63 ± 1.66

The means and coefficients of variation for length of tarso-metatarsus, body weight at 12 weeks and rate of growth from 8 to 12 weeks are presented in table 4. This table gives the constants for all the pullets, the three major groups and the differences between these three groups. The data for the 2 Anconas and single first generation hybrid are not presented separately.

Considering first the relative variability of the length of the tarso-metatarsus and weight it will be seen that weight of bird is more variable. This agrees with Schneider and Dunn (*19*). Rate of growth and weight are about equally variable and show similar fluctuations from group to group. The F_2 generation is the most variable in each case but the variability is not significantly greater in every case. There does not seem to be a significant difference in the backcrosses although the Ancona backcrosses ($F_1 \times$ Ancona) are more variable in each case.

The backcross on Light Sussex ($F_1 \times$ Light Sussex) were the heaviest and had the longest bones (tarso-metatarsus). They also grew more rapidly but the mean rate of growth was not significantly greater than that of the F_2 generation. The Ancona backcrosses differed significantly from the Light Sussex backcrosses. They had shorter bones (tarso-metatarsus), weighed less and grew more slowly.

The relationships between these three groups are presented graphically in figures 3, 4 and 5 which show the percentage frequency distribution. The ranges of the three groups overlap, but while the Ancona backcrosses are invariably represented in the classes near the lower limit and absent from those near the upper limit, the reverse is true of the Light Sussex backcrosses. The F_2 population is, in each case, spread more or less throughout the whole range. It may also be noted that all the curves appear to be monomodal. These results agree with those presented above on rate of growth. They indicate that there are pronounced differences in the genetic constitutions of these two breeds with respect to the factors studied. Furthermore, they show that the greater weight, longer bones and more rapid rate of growth of the Light Sussex are due to dominant genes which tend to segregate in the second generation. There is some indication that dominance is more pronounced in the case of rate of growth than in the case of weight and length of tarso-metatarsus. The results presented in table 4 also indicate that there is correlation between the length of the tarso-metatarsus, the total weight and the rate of growth. To test this the coefficients of correlation were computed. The symbols used are w — weight, t — length of tarso-metatarsus, and g — rate of growth. The simple and partial coefficients of correlation obtained were as follows:

$r_{wt} = + .752 \pm .045$ $\qquad$ $r_{w \cdot tg} = + .755 \pm .044$

$r_{wg} = + .172 \pm .100$ $\qquad$ $r_{wg \cdot t} = + .198 \pm .044$

$r_{tg} = + .056 \pm .100$ $\qquad$ $r_{gt \cdot w} = - .112 \pm .090$

Body weight and length of tarso-metatarsus are closely correlated which agrees with the findings of Latimer (*13*). The relationship is not influenced by rate of growth, since there is no difference between the simple coefficient and the partial co-efficient with rate of growth held constant.

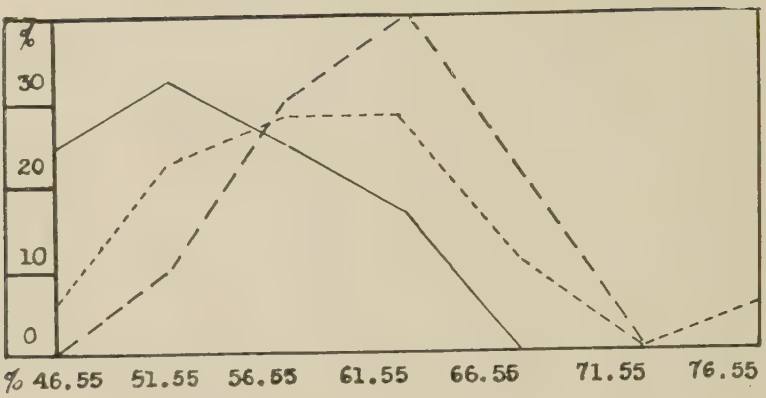

Figure 3. Percentage frequencies for rate of growth of females—8 to 12 weeks period. Legend: solid line, F_1 × Ancona: broken line (dash), F_1 × Light Sussex; dotted line, F_2.

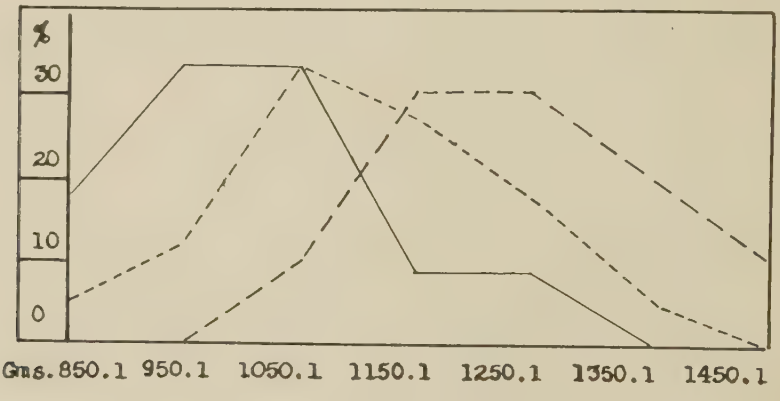

Figure 4. Percentage frequencies for body weight of females at 12 weeks of age. For legends see Figure 3.

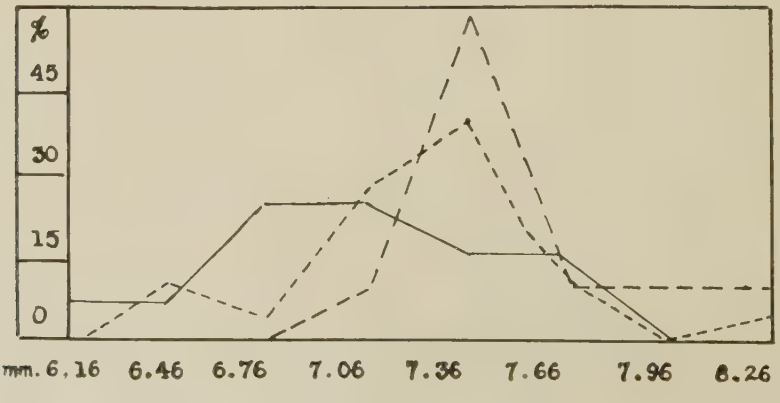

Figure 5. Percentage frequencies for length of tarso-metatarsus of females at 12 weeks of age. For legends see Figure 3.

The coefficients of correlation for rate of growth and body weight (+ .172 and + .198) are low, indicating that there is little relation between the weight at 12 weeks and rate of growth during the four preceeding weeks. Were weight at 12 weeks correlated with rate of growth during a longer period a higher coefficient would be expected. This higher coefficient would be due in part to spurious correlation. For the short period here used, however, rate of growth will apparently vary independently of body weight and length of tarso-metatarsus at 12 weeks of age.

Summary

1. Formulae representing rate of growth are discussed and reasons given for adopting the formula $R = \frac{(W_2 - W_1) \quad 100}{\frac{1}{2}\ (W_2 + W_1)}$ for this genetic study.
2. Data on the rate of growth of Light Sussex, Anconas and their hybrids (F_1, F_2 and backcrosses) are presented.
3. The feasibility of reducing growth rates to arbitrary figures by suitable formulae is demonstrated.
4. The data point to inherent differences in the rate of growth of the two breeds used. Furthermore, they indicate a complex mode of inheritance of rate of growth.
5. Genetic differences in body weight and length of tarso-metatarsus at 12 weeks of age are also shown.
6. A close correlation between body weight and length of tarso-metatarsus at 12 weeks of age is observed, irrespective of rate of growth in the 8-12 week period. No correlation is found between rate of growth from 8-12 weeks on one hand and body weight and length of tarso-metatarsus at 12 weeks of age on the other.

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PARTHENOCARPY IN THE CUCUMBER

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The phenomenon of parthenocarpy, i.e., fruit formation without pollination has been observed from ancient times, not in the cucumber alone but also in other species of plants.

Sturtevant (*3*) reports that over sixty species of plants show various degrees of seedlessness and says, "Some form neither seed nor fruit even when pollenized while others *form fruit but no seed when not pollenized.* This latter condition is known as parthenocarpy and the cucumber is the outstanding example". Among other common examples of parthenocarpy he mentions the apple, banana, fig, grape, pear and pineapple, and refers to various botanical and horticultural writers from the time of the Greeks (Theophrastus 3rd Century B.C.) who had observed this phenomenon. A seedless gourd and also a seedless cucumber are mentioned by Iben-al-awam, a Moorish Spaniard of the 12th century. Several ancient works are quoted by Sturtevant as giving directions on how to raise cucumbers without seed. (Geoponics lib xii C 19 and writings of Palladius).

The writer while carrying on breeding experiments with the cucumber noted particularly the numbers of fruits formed without pollination in the varieties under observation. Thirty-four varieties, with two to six plants of each, were grown under glass for these experiments. The growing conditions were favorable to rapid growth, i.e., good soil fertility, high temperature and high humidity such as are used by cucumber growers in England, but no shade was provided. It was found that all varieties and hybrids grown under these conditions formed some fruits without pollination as indicated in tables 1, 2 and 3. To determine whether a plant was forming its fruits parthenocarpically and not by accidental pollination a number of fruit were cut open (see plates 1 and 2)—if left on the plant for some time past the usual cutting stage some seed coats would form but no seed.

In the spring of 1931 several of the above varieties were grown again, namely, Early Frame, Earliest of All, Early Cluster, Japanese Climbing, Early Russian, Snow's Pickle and Arlington White Spine and all produced from several to many fruits, (Japanese Climbing many fruits) without pollination. Early Fortune was grown for the first time and it also produced fruit parthenocarpically.

To get some idea of the proportion of pistillate blossoms to fruit formed without pollination all the pistillate blossoms of one plant of each of twenty-seven varieties were marked on diagrams; as fruits formed they too were marked on the diagrams. The numbers of these blossoms and fruits together with the percentages of fruits formed are given in table 2.

Data shown in tables 1 and 2 give some indication of what may be expected of the varieties tested under the given conditions. They show at least that there is a wide variation in the ability of these varieties to form

[1]Assistant in Small Fruits and Vegetables.

TABLE 1.—*Cucumber fruits formed parthenocarpically by thirty-four varieties, grown under glass.**

Variety	1927 Spring April 26 to July 4 xx	xxx	1927 Fall Sept. 8 to Oct. 25		1928 Spring April 26 to July 12		1929 Spring May 30 to July 19		1930 Spring May 1 to June 30	
Everyday (selfed 1 year)	35.4	(5)								
Everyday (not selfed)	33.4	(5)	25.5	(2)	25.0	(4)	16.5	(2)	16.6	(3)
Delicacy	34.2	(5)								
Telegraph	28.8	(5)								
Princess	5.6	(5)								
Long Green Prickley	27.0	(2)								
Improved Long Green (a)	15.0	(5)								
Early Cluster	17.2	(5)								
Earliest of All	30.6	(5)								
Improved White Spine	18.2	(5)								
Arlington White Spine	21.4	(5)								
Early Frame	15.4	(5)								
Vickery (selfed 1 year)	29.0	(3)								
Vickery (not selfed)	——		20.4	(2)	28.2	(4)	21.0	(2)	18.6	(3)
Rawson Hothouse	24.6	(3)								
Vaughan	17.3	(3)								
Hescrow	38.0	(4)	17.0	(2)			11.6	(6)		
Deltus	23.6	(3)								
Abundance	18.0	(3)								
Davis Perfect	23.3	(3)								
Windermoor Wonder	26.0	(3)								
Early Russian	11.6	(3)								
Early Russian (selfed)	——		2.5	(2)						
Snow's Pickle	15.3	(3)								
Japanese Climbing	17.5	(2)								
China	20.6	(3)			15.7	(4)				
China (selfed)	——		12.0	(2)						
Chinese Evergreen	24.5	(2)								
Danish Pickle	28.0	(3)								
Crystal White	25.3	(3)	11.5	(2)						
Early Yellow Dutch	27.3	(3)								
Long White Parisien	——		4.3	(3)						
Fournier (a)	——		12.0	(3)						
Merveilleux Forcer	——		10.5	(2)						
Bangalore (b)	——				8.0	(3)	6.0	(2)		
Geneva (c)	——						22.3	(3)		
Deltus	——								16.6	(3)
Irondequoit	——								8.3	(3)

* In order to prevent pollination bees and other insects were kept out by screening the ventilators.

x Dates of cutting first and last fruits.
xx Average number of fruits per plant.
xxx Number of plants grown indicated by figures in brackets.
(a) These varieties may not be true to name.
(b) From Bangalore, India, no English name.
(c) A new hybrid from the Agr. Exp. Stn. Geneva, N.Y.

fruits in this way. Evidently some will form sufficient fruits to produce a commercial crop while others will not but the fact that certain of these varieties produce fruits at all without pollination is of particular interest. It is commonly said that some types will not produce fruit parthenocarpically, notably the American White Spine varieties,and there seems to be some evidence to show that under certain conditions this may be the case.

Wellington and Hawthorne (*5*) and Hawthorne and Wellington (*1*) report on work with the cucumber which they have carried on intermittantly since 1907 along similar lines. In their parthenocarpic tests they protected a number of pistillate flowers from pollination by covering with

TABLE 2.—*Record of parthenocarpic fruit formation in twenty-seven varieties of cucumbers. Count of pistillate blossoms and fruits made on 6 feet of main stem and on two three-foot laterals.*

Variety	No. of pistillate blossoms	No. of fruits	% of fruits to blossoms	Variety	No. of pistillate blossoms	No. of fruits	% of fruits of blossoms
Sutton's Delicacy	37	28	75.70	Improved White Spine	92	27	28.26
Sutton's Everyday	71	35	49.29	Crystal White	100	25	25.00
Earliest of All	79	38	48.10	Improved Long Green	65	16	24.61
Windermoor	63	29	46.03	Arlington White Spine	68	16	23.52
Telegraph	50	23	46.00	Early Yellow Dutch	125	29	23.20
Deltus	42	19	45.23	Rawson Hothouse	101	23	22.77
China	38	17	44.73	Vaughan	69	13	18.84
Danish Pickle	111	48	43.24	Japanese Climbing	143	23	16.08
Chinese Evergreen	81	35	43.20	Snow's Pickle	201	25	12.43
Hescrow	71	30	42.25	Early Frame	123	13	10.56
Long Green Prickley	92	37	40.21	Early Cluster	188	17	9.04
Vickery	129	44	34.10	Early Russian	251	14	5.57
Abundance	47	16	34.04	Princess	193	7	3.62
Davis Perfect	76	23	30.26				

carbolized vaseline and others with cotton batting in place of screening the ventilators. Under their conditions they did not get fruits to form parthenocarpically on certain varieties, namely, Early Green Cluster, Fordhook White Spine, Fiske White Spine and Arlington White Spine. According to Becker (1924) a German worker whom they quote (1928), "Parthenocarpy is present in most of the old English forcing varieties further in Weigelt's Bester von allen, Wettbewerb, etc. Non-parthenocarpic are Blaus Konkurnent, Becks Namenlose, etc." This apparently supports their contention that some varieties are parthenocarpic and others are not.

In the experiments at Vineland as already noted, no variety was found that lacked the parthenocarpic character and so no crosses could be made between parthenocarpic and non-parthenocarpic types. The hybrids obtained (table 3) all fruited parthenocarpically as readily as the parent varieties (tables 1 and 2) although not always giving as many fruits as some of the parents.

Wellington and Hawthorne (*5*) in their crosses, White Spine × Telegraph, White Spine × Richards Invincible and Arlington White Spine × Rockford Market—non-parthenocarpic by parthenocarpic varieties under their conditions—obtained no fruit without pollination in one lot of F_1 plants and they suggest that non-parthenocarpy may be recessive to parthenocarpy. In the cross Fiske White Spine × Early Russian and also in another lot of plants of White Spine × Richards Invincible they obtained one fruit from each in the F_1 generation from which they conclude that dominance of parthenocarpy may not be complete.

This difference in results obtained by Wellington and the writer is not easy to account for but undoubtedly the conditions of growth would be different and it is suggested that these would have a bearing on the formation of fruit.

This raises the question of the cause of parthenocarpy. Various speculations have been made on this point but there seems to be no record of any worth while work done in this connection.

TABLE 3.—*Cucumber fruits formed parthenocarpically by seven hybrids (F1 and F2 plants).**

Variety	1927 Fall Sept. 8 to Oct. 25*		1928 Spring April 26 to July 12		
	xx	xxx			
Crystal White x Vickery (F1)	11.5	(4)	21.5	(4)	
Vickery x Princess (F1)	10.0	(8)	19.5	(4)	
Early Russian x Everyday (F1)	6.62	(8)	28.7	(4)	
Princess x China (F1)	9.8	(7)	18.0	(4)	
Early Russian x China (F1)	11.25	(8)	17.5	(4)	
Everyday x Princess (F1)	13.37	(8)	23.0	(4)	(Also 132 plants V x E F2
Vickery x Everyday (F1)	14.0	(8)	27.4	(4)	gave parthenocarpic fruits
Vickery x Everyday (F2)	—	—	31.6	(12)	in 1929).

* Ventilators screened to exclude bees and other insects.
x Dates of cutting 1st and last fruits.
xx Average number of fruits per plant.
xxx Number of plants grown indicated by figures in brackets.

Even in ancient times, as already indicated, the idea was expressed that the cucumber could be made to form fruits parthenocarpically, but unfortunately no hint is given as to how this might be done.

Noll (*2*) suggests that the stronger the fruit bud the more possibility there is for parthenocarpy in the cucumber; he says, "being strong they can form fruits without the irritation of pollination".

Teidjens (*4*) reporting on some work on "The Relation of Environment to Shape of Fruit in the Cucumber" says in discussing "Effect of Light on the Development of Fruit" that, "Reducing the sunlight stimulated the production of seedless fruits on vines which would not produce fruit without fertilization during days of maximum sunlight. The parthenocarpic condition found in English varieties was induced in a non-parthenocarpic strain by changing the nutrition of the plant".

It would seem from the data presented herewith that parthenocarpy in the cucumber can be influenced by the environment although the degree to which any variety might respond would be determined by its genetic constitution.

Parthenocarpy in the cucumber is undoubtedly of much importance to the practical grower of cucumbers under glass. A variety that would form fruits freely without pollination and having also other desirable characteristics would be of considerable value, as much work and time spent on artificial pollination would be saved. Hence various attempts by plant breeders have been made to produce such a variety. A certain measure of success has been attained but the ideal has not yet been arrived at and it would seem that in addition to breeding work, attention should be given to the cause of parthenocarpy and to the possibility of its control.

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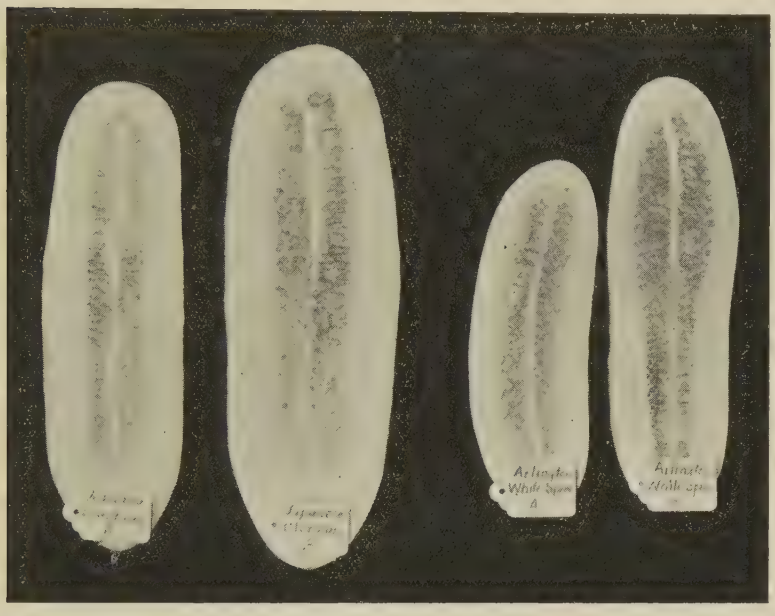

Plate I. Japanese Climbing and Arlington White Spine Cucumbers.
A. Parthenocarpic Fruit.
B. Pollenized Fruit.

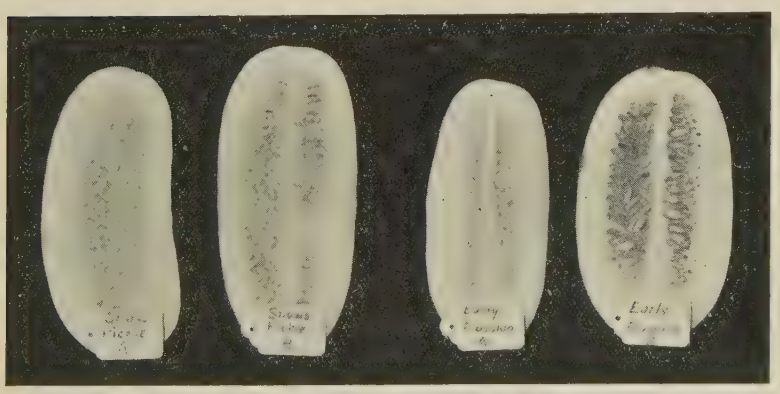

Plate II. Snow's Pickle and Early Russian Cucumbers.
A. Parthenocarpic Fruit.
B. Pollenized Fruit.

WHAT HAS THE ENGINEER FOR AGRICULTURE?

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The development of mechanical production in agriculture is one of the greatest engineering accomplishments in the history of the world.

The agriculture of North America is seldom discussed without stressing the use of machinery. Up until very recent years this machine production was pointed to with pride. Recently, however, it has become the popular thing to blame on machine production the surplus which, in turn, has been selected as the cause of price demoralization. Quoting the U. S. Department of Agriculture, Bureau of Agricultural Economics . . . "The net volume of all agricultural production in 1929 was about 4 per cent less than in 1928 and was further reduced about the same extent in 1930.

"It is obvious, therefore, that the great decline in farm prices and income in the past few months cannot be attributed to increased production in the United States. In the main we must look to the demand side of the price-making forces to find the explanation".

During the easy years of the past we became lazy in our thinking. We accepted too readily the things that crept into print or were spoken by men not hampered by facts. However, in all this economic whirlpool, the engineer has been inclined to stand to one side and express his opinion when anything appeared concerning which he was informed, and for the rest he was hardly interested. This is a fault of the engineer. We have heard it occasionally said that the machine age ruined the wheat farmer; if he could have stayed with the more simple machine, or even hand production, it would have been far better, for there would have been no surplus either in wheat or men. If this logic holds true, how about the great cotton crop of the southern United States? Here there is practically no machinery, the simple plow, walking cultivator and one-row drill being less complicated than the machinery used by the Russian peasant. Picking is entirely by hand. Yet this crop is suffering fully as much from low prices as wheat. It is not the machine, and it is doubtful whether the inability of the people of the world to consume agricultural or manufactured products is in any way an indication that they have enough of these products or do not want them. If all of the goods which are said to be surplus could be piled in one place and then all the people who really need these goods could get them, how long would the pile last?

This is essentially a country of pioneers. The early settlers left the established conditions of an old country and traveled into the new and unknown. Many people believe that the western part of our North American Continent is better suited to machine farming than the east. This is nowhere near as true of the land as it is of the people. The

[1] A lecture delivered to the Canadian Society of Technical Agriculturists on June 16, 1932, during the twelfth annual convention of the Society held at the Manitoba Agricultural College, Winnipeg, Manitoba.

[2] President of the American Society of Agricultural Engineers.

pioneer has confidence in the new. He will try it. He helps it succeed. There are those who, speaking *for* the farmer rather than *as* a farmer, point to the farm machinery standing in the farm yards and conclude that this represents a great waste and terrific burden on the farmer. Let me point out at least two considerations which seldom enter the minds of those discussing this subject.

First, is it possible, by a casual observation of disused machinery, to know what has been its record of accomplishment—how many acres plowed, drilled or harvested? If there could be attached to these machines a record showing their first cost, operating expense and work accomplished, could even then these critics determine whether it had been a good investment? If it were not customary to bury horses after they have rendered a life of service, what would people think of the animal as an investment if they could see piles of horse skeletons stacked up in a farm yard? Would our business friends think the adding machines and typewriters were such a splendid investment if, piled in the corners of their accounting rooms, were the old, worn out machines which had done so much to save expense, time and drudgery from the days of hand bookkeeping and the copy press?

In the show room of one of the manufacturers of combines, there is an old veteran recently retired from service. During its thirty-seven years of service on a western grain farm it cut, threshed and sacked over 1,275,000 bushels of grain. Through its faithful mecanism had passed enough grain to furnish every inhabitant of North America with bread for one meal. Yet if this work-worn machine were anywhere except in a display room these critics would say,—"*There* is an example of where the farmers' money has been wasted". It is true that machines have not always been good investments. There have been untrained salesmen and untrained buyers. Variable conditions have been encountered, conditions for which the machine was not originally developed.

The second observation I wish to make has to do with the real value of this training which the farmers of North America have secured in the use and management of machinery. He stands today head and shoulders above all the other farm operators of the world, not only in the skillful operation of machinery, but in what is more difficult to secure, and, that is, its management. There is no way to reach the top of a ladder without climbing a step at a time. Nations of the world who wish to excel us in efficiency of production will have to go the same road. Some of them have tried the detour, but they will find it more tedious and expensive and to be no saving of time.

Several years ago many of us were visited by representatives of the new government in Russia. They were studying agriculture in North America. They were doing much the same thing in all agricultural countries of the world. They selected as their goal a complete mechanism of their agriculture. This was primarily to ensure an ample supply of food and clothing for their own people, together with a surplus for export until their manufacturing program could be established. They reasoned that they had good soil, water sufficient for a number of world crops, heat

units to grow these crops and plenty of men, (or based on a year's first-hand experience in grain fields of that country I should say *workers*, which include men and women about equally).

In studying our agriculture, they listed carefully all the details concerning machinery used. They reasoned that all they had to do was buy similar machinery, read the directions for its use and then produce. But they failed to look into the mind of the North American farmer. They could not see the years of training in the care of his mechanical equipment, and, more important, the management of this new equipment which belongs to the machine age in agriculture.

Certain agricultural scientists not acquainted with the progress being made in the mechanization of agriculture are inclined to consider agricultural equipment as a constant instead of a variable. For many years the plow was considered as one of the foundation stones of agriculture. It has only been of recent years that the real objects of tillage have been studied and for many soils and climates the ordinary moldboard plow has been found to be either less efficient or more costly in its operation than the tillage machines which are superseding it. However, in all this array of new farm equipment which is coming before us today, we must keep in mind that engineering developments are never finished. Progress in this field, as in all others, may correctly be described as simply a continuous solving of our problems of today which arise from the solutions of the problems of yesterday.

What machinery has done to increase the effectiveness of labor and crop production has been the object of many studies. In the October, 1931 issue of the Monthly Labor Review, U. S. Department of Labor, there is a splendid summary of mechanism of agriculture. This report states that "the average increase in efficiency per unit of labor applied in the growing of five principal crops—corn, cotton, hay, potatoes and wheat,—by the substitution of the most efficient machines and methods for the earlier hand tools and hand methods, is approximately 1,200 per cent, and the labor displacement 80 per cent."

One of the outstanding examples of increased efficiency is that of the large type combine over the sickle and flail in the harvesting and threshing of grain. The gain in efficiency per unit of labor is 4,700 per cent and the labor displacement 98 per cent. The United States census showed 1,700,000 fewer workers on the farms of the United States in 1920 than in 1910 yet during this period there was an increase in the quantity of each of the important cereal crops. This increase was as high as 30 per cent in the case of wheat. A century ago the production of an acre of wheat required 60 hours of human toil. Today the labor requirement per acre has been reduced to as little as 54 minutes of man labor. The average for a modern mechanized wheat farm is from 2 to 4 hours.

We hear today the paradoxical twin fears; first our over-production of agricultural products, and, second, the danger we face because farmers are leaving the land.

Some social students are stoutly maintaining that every man should have the *privilege* of returning to the farm whenever industrial competi-

tion becomes to severe. One of our national weeklies has undertaken as a major project the *sending* of men *back* to the farm. I wish to point out that there are two things wrong with this picture. In the first place, people are nowadays not being *sent* places to which they do not wish to go and most of the people who are now eligible to be sent would not be going *back* to the farm because they never have been there. But let us assume that millions of people could and would add their numbers to those now engaged in farming. There would be a quick retreat from the use of machinery. It is entirely possible that if all the people in the United States were tomorrow furnished with the simple hand tools of agricultural production, which were in common use not much over a hundred years ago, within less than five years this country could not produce enough to feed ourselves. The American farmer today utilizes animal and mechanical energy to the extent of at least 110,000,000 hoursepower hours per day during the one hundred most busy days of his tillage, planting and harvest seasons. This is so much more power than it would be possible for all the able bodied inhabitants of the United States to daily produce, with their own muscular energy, that the result would be such a great reduction in food supply that the entire nation would be constantly bordering on starvation.

Consider, for example that with muscular energy alone many of our irrigated lands, where water is pumped from deep wells, could not be farmed. Semi-arid regions with every need for extensive weed control and rapid plowing and seeding, would offer insurmountable difficulties to hand production. Plant and animal diseases and pests which multiply so rapidly when similar plant or animal life is crowded into small areas could not be controlled. It is very likely that civilizations of the past, which grew up and flourished, were wiped out by the attack of the pest on their concentrated crops. Today the machine is used to spray, to dust, to till cleanly and to plant quickly. With a hand economy in agriculture, requiring the work of everyone on the farm, there would be no need for cities, railroads, banks, insurance companies or colleges, yet this is the end point of the Back-to-the-Farm-Movement and subsistence farming. Those most loudly advocating this plan would be the last to go out and cast their lot with the man with the hoe.

Previous civilizations have been based on hand labor and the slave. This civilization is based on the machine which is the willing slave of the man, but can never become his master. There are a few whose minds like to toy with the idea that the machine is ruining us. But the author of these ideas, after writing his daily column, is most willing to ride in the labor-saving elevator, drive his car to a home in the suburbs, turn on a light, a fan or a heater with a push of a button ,and enjoy the world news from a paper which is the result of the utilization of every modern means of communication and mechanical production. If more people would practice before they preached there might not be so much preaching.

No matter what happens, men are going to think. They are going to develop new ways to save labor and accomplish results. Once we have

enjoyed conveniences over hand labor and slavery, we will never return to hand labor. Man has harnessed the sun; he has unlocked the stored up power of coal, petroleum and moving water. He is replacing muscular energy. Vegetable oils, or other plant materials, will be developed as another source of energy, and electricity will likely ever remain with us as an incompleted mystery.

The engineer, to make his greatest contribution to agriculture, must come out from under the cloud of over-specialization. The engineer is clannish. He is so busy applying the laws of mathematics and physics that he tends to forget the humanities. Dealing only with facts, he creates the new. He has developed a near contempt of those dealing with the unknown or with the many variables tied up with human behavior. But the engineering is not the only one suffering from over-specialization. Our agricultural colleges must share this blame. They have taken agriculture apart and each branch, and, in some cases, twig, have been dragged off into a different corner for scrutiny and alterations. When the parts are brought back, if ever, to the parent, they sometimes will not fit and too frequently the experimenter does not care, since his major interest is in the science of his specialty rather than in service to the betterment of agriculture as a great and essential industry. Specialization tends to breed preconceived ideas. Unconsciously experiments which are undertaken are expected to turn out one way. If they go the other, something must be wrong with the apparatus or method. Is it true that widening the base or breadth of our knowledge will necessarily decrease the height of our development in any one field? A broad educational base makes possible a more dependable development because we are enabled to draw upon a greater variety of experience and knowldge. Specialization may be dangerous in any field. Social specialization produces unworkable plans. Engineering specialization produces a disregard for social unrest.

But what has the Engineer for agriculture? You are familiar with the effect of engineering development on agriculture at present. I am going to assume that many of you have read the splendid essay on Canadian agricultural problems prepared by your colleague, Andrew Stewart. His essay, entitled, "Economy of Machine Production in Agriculture" was awarded first prize in the contest established by the Royal Bank of Canada. In reading this essay, I marked many pages for quotation in this paper, so many, in fact, I am simply urging all of you who have not done so to read the essay.

Some accuse the Engineer of plotting against the freedom of farm life, of building toward great corporation farming. This is not the case. Through the making available of larger machine units, which can be operated by one man, the engineer has increased the size of the family farm. He has made it possible for the family farm to produce more units of crop. This has resulted in a material decrease in the cost per bushel. The family farm is today more firmly established, as the most efficient producer, than ever before in the history of agriculture. It is truly a *family* farm, without the need for the great seasonal influx of itinerant laborers, or the continuous presence of a number of hired hands. For

those who maintain that agriculture is not an industry, but a mode of living, it can only be said that for any desirable mode of life there must be a profit to supply those things essential for the maintaining of a happy existence. In the case of the three prairie provinces of Canada, the years 1921 to 1926 showed many changes. There was a material decrease in the number of farms, but the average size of the farm increased sufficiently so that the net result was a gain in acreage. Fourteen thousand, or one farm in seven of all farms under 161 acres were abandoned; 4,500, or one in 25 of all farms between 161 and 480 were abandoned, while but 392, or one in one hundred, of the farms over 480 acres were abandoned.

There is now in the press a most valuable bulletin, entitled, "Farm Organization as Affected by Mechanization" prepared by Professor E. A. Starch of the Department of Agricultural Economics, University of Montana. This bulletin deals largely with reports of machinery performance on the Fairway Farms project. In the introduction there is the following table and comments having to do with the increase in acreage and the shift toward mechanization:....

"A study of 100 leading mechanized farmers in northern Montana shows that these 100 farmers doubled their tilled acreages in the five years, 1924-1929. The increases in acreage by years were as follows:

Year	*Acreage*	*Year*	*Acreage*	*Year*	*Acreage*
1924	627	1926	790	1929	1,284
1925	688	1927	948	1930	1,297
		1928	1,140		

The acreage which each worker can care for has increased tremendously, as in none of the above instances has the number of men on each farm increased but rather it has decreased over the same period of time.

The significance of the change can best be illustrated by comparison.

A man with a four horse team could farm approximately 200 acres of land and on an alternative crop and fallow basis, he would have one-half of 100 acres in crop and 100 acres in fallow. With a 12-horse team, he could handle 640 acres, and with a 16-horse team 800 to 900 acres. With a three-plow tractor, the same man can take care of 800 acres, with a four-plow tractor 1,100 and with a six-plow tractor, 1,800 acres of land if in each case an alternate system is followed, having half the acreage in fallow and half in crop. Thus, the operator finds himself in a position to cover increasing numbers of acres with the same amount of effort on his part by increasing the power under this control.

THE SHIFT TO MECHANIZATION:—It has been previously stated that one of the forces which tended to change the farm organization was the realization that the net production per acre under dry land conditions was less than under humid conditions of the middle west. Thus, there was a choice between the alternative of accepting a lower standard of living or increasing the number of acres.

The natural tendency was toward the latter and consequently, a demand arose for power and equipment combinations which would permit the farm operator to have enough power at his control to cover the necessary acreage. Horse power grouped together in big teams made this possible and by 1913 big teams became very general. One man driving 12 or 16 horses could work three or four times as much land as he could before, when he was driving 4 or 6 horses. Thus, he could cover enough of lower productivity acres to yield a satisfactor income. Big teams proved to be a very economical source of power.

The Increased Use of the Tractor: The tractor superseded the big team and is now the most common source of power on Montana dryland farms.

The new type of medium-sized tractor began to make its appearance in the state in 1924. That year was a good crop year, prices were high and several hundred tractors were purchased. The replacement of other power by this type of tractor moved on with increasing rapidity each year as its ability for speeded production became known to the farmers. The better than average crop yields of 1924 to 1928 gave an added impetus to the change. In general, it gave the agriculture of the area a decidedly greater production at a lower cost than would otherwise have been possible. There were farmers among the entire group which did not invest wisely in some cases, as they equipped land which is not suitable for wheat growing in the long run. Some other farmers over-invested in power and equipment considering the size of unit which they operated".

One of the most significant statements which I have heard concerning modern farming was made by Dr. W. H. Fairfield, Director of the Dominion Experiment Station, Lethbridge, Alberta. In commenting on modern wheat farming in the prairie provinces, Dr. Fairfield stated that, if he were to start in the wheat producing business in Canada, he would require sufficient capital to secure a completely balanced set of mechanical equipment for the producing of wheat on the area which he had selected. This area would have to be a section or more. After securing the equipment, he would then proceed to locate the exact piece of land on which he would operate. In other words—this is almost a complete reversal of the former plan, which was to secure the land and then invest what capital—if any remained—in some simple equipment. In an agriculture producing a surplus of products, it is apparent there is a surplus of land. This makes possible a choice of location and tends to place ability to produce at low cost ahead of ownership, or right to the use of a certain piece of land.

In the very recent bulletin entitled "Cost of Producing FarmProducts in the Prairie Provinces", prepared by the Dominion Experimental Farms, it is shown that the cost per bushel of wheat decreases from 79½c on a half section horse-operated farm to 51.1c on a three section tractor-operated farm. On farms of a section or larger, the most economical production was secured with a tractor and combine. This bulletin contains a valuable analysis of the management of animal and mechanical power in grain production outlining the conditions for which each type of power is best adapted.

No nation will profit by failing to recognize facts. In this era of international competition, low cost production will rule. Any measure taken which will tend to offset or nullify the effect of low cost production will be found to be temporary in nature or an ultimate dis-service to the people. The farmer is in a most favored position in so far as his products are absolutely essential. They are in everyday demand by the human race. With him it is more than ever necessary that every step be taken to reduce production costs. The Engineer never writes "finished" after any development. Each new step in efficiency is simply a spur toward the next. In the bulletin just referred to, it is shown that the combine saves from 7 to 14c a bushel in the cost of harvesting the crop. Agricultural engineers from a western agricultural experiment station have recently reported completion of a job of plowing 7,000 acres of wheat with a new type of Diesel-operated tractor. The 7,000 acres were plowed with 16″ mold-board plows in 46 days, or 1,055 hours, i.e. 6.5 acres

per hour. A consumption of .78 gallons of 7½c fuel oil per acre was recorded. The total labor and fuel and oil costs per acre was 12¼c. This engine (which will operate on any vegetable, animal or mineral oil which is free from water or grit) is another contribution toward the reducing of power cost in the growing of wheat. The Oregon agricultural engineer made the statement that at the completion of this 7,000 acres of plowing, while the tractor upon examination was found to be in first-class operating condition in every way, the owner could have given the entire outfit away and charging every expense, including 100 per cent depreciation on the outfit, his plowing cost would have been but $1.30 per acre.

While the engineer has given particular thought to the reducing of acre costs, he is now turning more attention to the increasing of yields. He is helping the soil technologists to produce tillage equipment for more efficient weed control and moisture conservation. Machines for the application of fertilizer, which result in uniform and quicker ripening and greater yields, better seeding devices and more economy in harvesting, are all pointing the way toward increases in crop returns per acre which, for the farmers of the future, will likely mean the difference between profit and loss.

Agriculture has to overcome many handicaps. There are tenants who are operating under the direction of those who have seemingly but one interest and that is to be relieved of the responsibility of farm management as far as possible. These absentee owners sometimes take the attitude that machinery is a necessary evil, and the less they have the better. The human is essentially a lazy animal. When ditches could be dug as cheaply with a pick and shovel, the contractor, or foreman, had no incentive to assume the ownership and operation of the ditch-digging machine. It was only through the plan of awarding contracts to low bidders that the contractor left this lazy method of supervision for the one which called for greater responsibilities and greater profits. For those who think that the machine is enslaving us, let them try equipping a farm with new machines and then turn it over to a lazy or incompetent operator. This operator or "slave" will soon have his machinery "lords" under his complete control, whimpering in the fence corners for lack of oil, adjustment or care. The machine is no master, it is a servant and with intelligent care and opportunity for service it returns many-fold to its owners.

In the past, agriculture has secured but little of the total engineering talent of the world. Transportation, communication, construction and manufacturing have all asked for and received this assistance. The spokesmen for agriculture stoutly maintained that here is not an industry but a mode of life. It was necessary for crops to be produced with human toil. Later, animal power was considered essential. Buildings were simply put up. Where the engineer would carefully study the routing of materials through a factory there were few who interested themselves in trying to save the steps of the farmer or his wife. Why bother to save steps? They cost nothing. The fact of the matter is that the statement "labor-

saving machinery" has always been a misnomer. Machines have seldom been purchased where the sole reason for securing them was to save human labor. They were adopted because they allowed the user to produce more with the same input of time. It will be largely through a more complete knowledge of the crop yield and quality value of timely operations that many of our new developments in agricultural equipment will be prompted. Agriculture to succeed must have a profit. No mode of life can possibly be looked upon as desirable unless it affords the means of supporting an acceptable standard of living.

The agricultural engineer is now looking toward an increased industrial use of agricultural products. We are entering an age of temperature control which means insulation. Chemistry is unlocking the door to new uses for many of the waste products of agriculture. Commercial use for products from straw and corn stalks is causing the development of new types of harvesting machines which will deliver these waste products in a form usable in the factories producing building and insulating materials, cellulose or rayon, and a multitude of other products.

There is ahead a great period of development in agriculture. The people of the world are not going to condemn themselves to a life of slavery to the soil. In the great scientific age ahead people will learn to live together, to trust and not to hate. The engineer, through transportation and communication, has brought the world together so quickly that the neighbors have not yet become accustomed to seeing each other over the back fence. While the first impulse is to build the fence higher, soon people will realize that they will all be happier if the fences are removed. It is said that science knows no geographic boundary. It is, therefore, the double task of men engaged in scientific work to bring forth new facts and through their desire and willingness to coöperate and help their fellows regardless of race or tongue, to point the way toward true neighborliness among nations.

RESEARCH TODAY [1]

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The choice of subject was made for me doubtless in view of the fact that research seems under present conditions to need support. It is inevitable that all expenditures of funds should be carefully scrutinized at the present time, and research programmes are somewhat less examinable than other fields of work on which money is being spent. It needs only some thought however to convince us that the civilization which we enjoy is dependent on the continuation of research work. The scientific age differs from the previous periods in the world's history primarily in this, that the world has become a plastic medium, moulded to the needs of man by the tool of the experimental method; while in previous civilizations the desire has been to mould man to the demands of nature, for man was unable to mould nature to his needs. Progressively the world becomes more amenable to the powers of man; progressively it changes at man's behest. Among the characteristics of our scientific age one need refer only to the fields of plant and animal breeding to indicate to you some of the important directions in which nature has become plastic under the spell of scientific knowledge. There is, however, a possible danger in this process. It seems more than probable that any modification that is made by man, disturbing the normal course of nature, leaves open a point of attack by nature herself. A new cereal carries with it its own danger, hitherto possibly unknown or unperceived. The equilibrium is not at once established, and nature has her revenge. The scientist must be constantly on guard, constantly on the defensive against nature's counter attacks. He cannot stand still. He has involved himself and his world in a process for which there can be no rest, no cessation of labour. Scientific work carries with it its own demands for further and still further scientific work, if our civilization is to go forward—if indeed it is to remain safe. This is a sufficient reason for continuous progressive research. The world cannot afford to do without it. The scientist is an essential link in the civilization which we are building up and endeavouring to protect.

To many of us one of the most striking and satisfying conditions of our time is that public policies are formulated on the results of scientific investigation, and that governments wait on the scientist in order that policies may be sound. This is as it should be; but I do not know that we realize how fully it has come to pass, nor are we sufficiently grateful that governments place their confidence in scientific men. Science has a field remote, not easily understandable, possibly somewhat unpractical in its outward appearance. It might hardly be expected that men of affairs, who have to act on the exigencies of the moment, should build on the evidence of scientific effort; and yet it is so. It is a further illustration of the fact that we live in a scientific world, where policies which are today

[1] Summary of a lecture delivered to the Canadian Society of Technical Agriculturists on June 17, 1932, during the twelfth annual convention of the Society held at the Manitoba Agricultural College, Winnipeg, Manitoba.

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mainly economic in character must rest on facts established by science. It is for this reason that governments have been generous in their support of scientific endeavour in the field of agriculture as in other fields of investigation.

Those who are responsible have therefore all the more reason to ask that the funds be wisely used. In my judgment there is no criterion which will ensure this except that the men who are permitted to do scientific work should be men of first class ability. It is a field which demands thorough and sound fundamental training, imagination, initiative, patience, continuous accuracy and a freedom from desire to appear in the limelight. Only few men have those characteristics, and other men may well misuse funds devoted to research. If one could be assured that only first class men are permitted to go forward,there is no sound alternative but to give them the widest freedom of action. Research work cannot be carried forward in any very narrow plan. Freedom is part of the life of the research worker. If he is hampered his abilities are restricted. Particularly at the present time, when many men desire to go forward to graduate work because of the economic conditions, will it be necessary for universities and research institutions to insist that none but the best go forward. If we are satisfied that the work is being carried forward by men thoroughly fitted for the work we will have no cause to worry about the misuse of research funds.

I have spoken of the wider field of research. There are some phases of its application to agriculture on which a layman may be permitted to speak. The field is wide and is continuously widening. Agriculture has called on the zoologist, the botanist, the chemist, the biochemist, the pathologist, the entomologist, the physicist, the geneticist, the nutritionist and many more. It demands that these be men thoroughly trained in the ground work of their science. I do not believe in agricultural chemistry. If a chemist is to give service to agriculture he must be thoroughly a chemist. That is the point of view which I feel is growing in the minds of those who are dealing with the professional training of applied scientists. In any event I can say with definiteness that an economic geologist is of no value unless he is a thoroughly trained geologist. But there are certain specific fields in which one may be permitted to present some viewpoints. I have been interested in a bulletin prepared by the National Research Council in Ottawa on agricultural waste materials, partly because the matter of the use of waste materials is important, and partly because it challenges the attention of scientists outside the field of agriculture. The utilization of the broken wheat from the refuse screenings challeges attattention. If from this material alcohol can be obtained at a lower figure than that from imported molasses, there is an opportunity to increase somewhat the price of wheat by giving greater value to what is at the present time mainly refuse material. The dairy industry is one of our largest Canadian industries. Of the seven and one half million tons of milk produced in Canada in a year almost one half becomes a refuse material in the form of skim-milk, butter milk and whey. If from this material there could be produced casein which is today finding considerable use as a filler and a plastic, the value of the dairy industry could be

greatly increased. If in the growing sugar-beet industry still better use could be made of the molasses and the pulp—and there are other possibilities—much might be done to assist an important industry at its most difficult stage. If from the inferior wheats glutamades could be manufactured to obtain a wide market the wheat growing industry in Canada would be directly benefitted. And these are only a few suggestions among many. They are sufficient to indicate that the chemist and the physicist and the biochemist have a fruitful field in developing out of waste materials valuable products in Canadian industry, thereby assisting the primary producer to a more stable market.

In the West as elsewhere we have been much concerned in recent months with the economic aspect of production and marketing. May I make a plea for more serious training of the economist in agriculture. They are all too few among us as a group of agricultural workers. The Agricultural Economics Branch in Ottawa has initiated work of great importance and we in the provinces must assist by supplying men who are first class economists and thoroughly familiar with agriculture. The problems that they face are many—the most difficult of the present time—and make great demands on men of ability and training. And in connection with the economic relationships we cannot today neglect the wider fields of sociology and psychology in the sound settlement of peoples under frontier conditions. It is essential that the physical scientist and human scientist joins hands, and that they work together in problems which are indissolubly related, and which cannot be dealt with in independent sections. Experience as a member of the Canadian Pioneer Problems Committee has taught me, as probably nothing else has done, that the time is ripe for a combined attack on our problems by the physicist and biological scientist on the one hand and the human and social scientist on the other. They have stood too long apart from each other. Our modern problems demand joint attack. It is in this field that the Canadian Pioneer Problems Committee has done a piece of work which, in my judgment, will be a forerunner to much of the work of the next twenty years in the field of research.

May I also be permitted to say a word about the utilization of research work. The scientist writes as a rule only for the scientific paper where the record of his work will remain permanently on the tables of science. The agricultural scientist is working as well—and very directly—for the farmer, who cannot understand the language of the scientist. There is an imperative demand that the results of scientific research be written as well in the language that can be read by the man who will put such results into practice. If the scientist cannot do so himself he must see that some one else who is competent will do it for him. Moreover, no matter how engrossing his research, he must not permit himself to lose contact with the man on the farm and his problems. The direct application of scientific research will come best through personal contact and appreciation of the scientist by the farmer and of the farmer by the scientist. Under our conditions no other method is sound today.

There is in the minds of all of us the question as to whether there is overlapping in the field of agricultural research in Canada. As a layman

I am not in a position to answer the question. It is however my experience that the soundest way to prevent overlapping is to make possible the meeting together of scientists who are working in closely related fields. They discuss their work, they learn the aims of their brother scientists, and inevitably they avoid overlapping. I know of no other sound way. Many research men are connected with universities, many with administrative departments, many with research institution. Wherever they may be placed they are happiest in a relationship self-contained and not too closely connected with the administrative side of governmental work. They are of a different temper. There is demanded of them other qualities. It is in my judgment always sound that they be separated to some extent, whether under the same organization or otherwise, from the purely administrative officer. That can be achieved satisfactorily under any conditions, and if it is achieved and if at the same time as full opportunities as possible are given for the men to meet together to discuss their problems of work, we need have no fear that the money spent on research will be ill-spent nor that duplication will occur in the carrying forward of such work.

LA PROPHYLAXIE DE L'AVORTEMENT EPIZOOTIQUE DANS QUELQUES PAYS D'EUROPE.

Maurice Panisset
Docteur-Vétérinaire (Alfort)
Professeur à l'Ecole Vétérinaire de la Province de Québec.

Point n'est besoin d'une longue enquête pour voir que les méthodes qui sont préconisées généralement sur le continent nord-américain contre l'avortement épizootique sont loin de présenter le maximum d'avantages pour un minimum d'inconvénients.

Dans les troupeaux où se sont manifestés des cas d'avortement on recherche à l'aide de méthodes spéciales (séro-agglutination, fixation du complément) les reproducteurs dont le sérum fournit une réponse positive à l'épreuve choisie. Ces sujets sont considérés comme dangereux pour leurs congénères et en ce qui concerne les femelles, comme destinés à présenter dans la suite de leur carrière économique des avortements répétés. Ces "réagissants" font l'objet de mesures spéciales ayant pour but de les éliminer des troupeaux et de soustraire leurs congénères aux atteintes de la contagion. On conseille soit leur abatage pour la boucherie, soit leur isolement rigoureux dans des étables spéciales composées uniquement d'animaux considérés comme infectés.

Loin de nous la pensée de nier toute valeur aux méthodes sérologiques qui sont utilisées dans le diagnostic de l'avortement épizootique, mais nous croyons que l'on a une grande tendance à leur faire fournir des renseignements qu'elles sont incapables de donner. La réaction d'agglutination qui est le plus souvent utilisée est basée sur le fait que le sérum provenant d'un animal qui *a été* ou *est actuellement* infecté par le microbe de l'avortement (Brucella Abortus) détermine la production d'amas de microbes de l'avortement dans une suspension homogène de ces microbes, phénomème qui ne se produit pas avec le sérum fourni par un animal n'ayant jamais été en contact avec Brucella Abortus. Mais comme l'a écrit très justement R. Moussu "l'agglutination qui décèle la présence d'anticorps dans le sang n'est pas synonyme d'infection; . . . c'est une réaction de présence, et rien autre chose, qui peut être obtenue aussi bien par l'injection de microbes morts à un sujet réceptif que de microbes virulents à un organisme réfractaire". Et pourtant ni dans le cas de l'organisme réceptif qui a reçu des microbes morts, ni dans celui de l'organisme réfractaire qui a reçu des microbes vivants,le sujet ne peut être considéré comme infecté.

"L'agglutination positive ne signifie qu'une chose: la présence antérieure ou actuelle de Br. Abortus dans l'organisme qui a fourni le sérum. Elle ne donne aucune indication sur l'évolution ultérieure de la gestation, sur la possibilité d'un avortement."

Et les exemples ne manquent pas, nous avons eu maintes fois l'occasion de le constater, soit par nous mêmes, soit par les rapports de confrères, de vaches n'ayant jamais avorté, entretenues dans des étables où l'avortement épizootique n'a jamais fait son apparition, et dont le sérum présente néan moins une réaction fortement positive.

La réaction d'agglutination ne peut donner de résultats absolument certains pour diagnostiquer la nature exacte d'un cas isolé d'avortement (avortement épizootique, avortement microbien dû à d'autres germes que Br. Abortus, avortements en série dûs à des causes accidentelles: toxicité des fourrages par exemple). Ce diagnostic initial est le plus important et il doit se baser sur la constatation de manière irréfutable de sa spécificité, c'est à dire sur l'isolement de Br. Abortus, soit des enveloppes fétales, soit de l'organisme de l'avorton.

Le pronostic de l'affection, c'est à dire la réponse à cette question: cette vache qui présente une réaction d'agglutination positive avortera-t'elle au cours de ses gestations ultérieures, ne peut pas d'avantage s'appuyer sur des résultats sérologiques.

Tout cela ne veut pas dire que la réaction d'agglutination ne doive pas être pratiquée dans les étables atteintes d'avortement épizootique, mais elle doit l'être à bon escient. Le diagnostic bactériologique d'avortement épizootique ayant été fait une première fois, la recherche de la réaction d'agglutination pratiquée sur les sérums de tous les reproducteurs de l'étable, indiquera le degré d'infection de l'effectif sans que pour cela il faille trop attacher d'importance aux résultats individuels.

De même la réaction pratiquée à plusieurs reprises sur un animal, dans le cours d'une ou plusieurs années, pourra donner des renseignements intéressants sur l'évolution de la maladie chez cet animal.

Dans ce cas comme dans le premier, c'est toujours une série d'épreuves que l'on devra avoir à interpréter, une épreuve isolée ne pouvant pas donner de certitude absolue.

On a trop laissé croire que la spécificité de la réaction d'agglutination pour le diagnostic de l'avortement épizootique pouvait être comparé à celle de la réaction à la tuberculine chez les animaux tuberculeux, à la malléine chez les animaux morveux. R. Moussu a fait remarquer que "l'exemple des Etats-Unis qui ont pu grâce à la tuberculinisation faire reculer très sérieusement la tuberculose, alors que l'avortement épizootique y est plus florissant que jamais malgré l'emploi systématique de l'agglutination, montre bien la différence entre les résultats que peuvent donner les deux méthodes".

Les mesures prophylactiques qui sont préconisées à la suite de la constatation de l'avortement épizootique dans une exploitation sont loin d'être dépourvues d'inconvénients. Elles se basent sur la constitution de troupeaux sains dépourvus de manière absolue de sujets réagissants, sur l'application au sein de ces troupeaux de mesures hygiéniques, de mesures de protection concernant l'achat de nouveaux sujets.

Nous sommes loin de contester la valeur théorique de cette manière de procéder, mais à quels inconvénients, voire à quels dangers ne conduit-elle pas dans la pratique.

Aucune loi n'a encore réglementé la vente des animaux atteints d'avortement épizootique. Lorsque l'on recommande au cultivateur de se débarrasser de ses animaux infectés, il va peut-être tenter, non de les faire abattre et de disposer de la viande, mais de les vendre à un autre cultivateur

pour l'élevage. Il se peut que l'acheteur soit informé de l'existence de la maladie dans l'étable du vendeur et renonce à acquérir un animal qui peut apporter l'infection dans son troupeau; très souvent la vache à réaction positive sera introduite sans autres précautions parmi des animaux sains et la maladie fera son apparition dans ce nouveau troupeau. Seule une législation appropriée—nous verrons qu'elle existe dans certains pays—mettra les éleveurs à l'abri de semblables risques, mais plus encore que le législation, l'éducation du cultivateur sur les dangers de l'avortement épizootique l'amènera à entourer ses achats de certaines garanties sanitaires.

Il arrive parfois que dans une petite exploitation pauvrement installée de très nombreux avortements se produisent et que l'épreuve d'agglutination indique une proportion élevée de réactions positives—60% de l'effectif, par exemple. Il ne sera guère possible de demander à ce cultivateur déjà fort éprouvé par les avortements successifs qui se sont produits dans son troupeau de vendre d'emblée plus de la moitié de ses animaux, quelles que soient les conditions du marché; et, s'il le fait, comment va-t-il pouvoir assainir cette étable basse de plafond, mal éclairée, parfois sans plancher, et pouvoir y introduire sans danger des sujets sains?

Il est un fait bien connu qui doit rendre non moins prudent dans l'établissement de mesures sanitaires, c'est que très souvent une vache qui a avorté une fois, deux dois, mème à bien toutes ses gestations ultérieures, et cela sans avoir été jamais l'objet de soins particuliers. Sans doute elle reste infectée, elle reste dangereuse pour ses congénères, mais elle semble s'être accoutumée aux microbes qui l'infectent et ne présentera plus dans la suite cette manifestation fâcheuse de la maladie qu'est l'avortement.

On voit donc à ces quelques exemples que les divers problèmes que pose l'avortement épizootique ne sont pas encore résolus de façon irréprochable. In semble que de grands progrès puissent être faits en s'inspirant de l'expérience d'autres pays qui se sont trouvés en présence des mêmes difficultés et ont employé des méthodes sensiblement différentes pour les résoudre. Nous voulons parler du travail qui a été fait en Allemagne et dans les Pays Scandinaves contre l'avortement épizootique, travail qui a été entrepris de façon méthodique sur de vastes territoires et non pas seulement dans quelques exploitations particulièrement bien outillées et suffisamment riches pour faire les frais de la lutte.

Au Danemark, les mesures légales contre l'avortement datent de 1920. Elles sont basées sur la déclaration obligatoire des animaux infectés et un ensemble de règlements restreignant en fait la libre disposition des animaux infectés. Elles amenèrent de telles protestations de la part des éleveurs propriétaires de troupeaux infectés qu'elles durent être amendées en 1927. Actuellement, voici les mesures qui sont restées en vigueur.

Dans toute exploitation où est survenu un cas d'avortement contagieux, le propriétaire est tenu aux précautions suivantes pendant un délai qui est fixé par le Ministre de l'Agriculture:

1—Il ne doit pas conduire à des pâturages communs les taureaux, les vaches en gestation et les génisses présentant des écoulements utérins.

2—Il lui est interdit de vendre, sauf pour les faire abattre, des vaches et des génisses, à moins que l'acheteur ne soit informé par le propriétaire lui-même que l'avortement épizootique sévit dans son étable.

3—Il ne doit pas accepter pour la saillie des vaches et des génisses appartenant à des étables saines, sans informer le propriétaire que l'avortement épizootique sévit dans son étable.

4—De même, il ne doit pas conduire ses vaches ou génisses à des taureaux étrangers sans informer le propriétaire de l'état sanitaire de son étable.

Ces prescriptions prophylactiques semblent être rigoureusement appliquées, mais d'autre part les tribunaux civils ont eu une influence très heureuse sur l'efficacité des règlements. En effet, ils admettent très facilement que la vente d'un animal atteint de l'avortement épizootique constitue un manquement à la garantie due par le vendeur d'animaux. Si l'introduction d'une vache infectée dans une étable saine a été la cause de dommages pour l'acheteur,le vendeur est tenu à l'indemniser de toutes les pertes causées par la propagation de l'avortement épizootique dans son effectif, de tous les frais directs ou indirects occasionnés par la maladie. La crainte des dommages-intérêts à verser a beaucoup fait pour rendre les éleveurs prudents et pour enrayer la diffusion de la maladie.

D'après les statistiques du Laboratoire de Copenhague la propagation de la maladie semble être arrêtée dès à présent.

L'arrêt de l'extension de la maladie dans le pays ne représente qu'une partie du problème; il faut encore supprimer l'infection ou tout au moins en amoindrir les effets dans chaque exploitation prise individuellement.

L'expérience danoise montre que l'élimination immédiate des animaux présentant une réaction d'agglutination positive ne donne de résultats que lorsque le troupeau a été récemment contaminé. D'après C. O. Jensen, 30% des étables ont de cette facon été préservées de nouveaux cas d'avortement. Des essais ont été faits pour généraliser cette méthode d'éradication à toutes les étables infectées, mais elle s'est révélée comme impraticable en raison de la valeur considérable des animaux à faire abattre et de l'impossibilité de les remplacer immédiatement dans les troupeaux ainsi décimés. La lutte individuelle contre l'avortement semble être au Danemark laissée à l'initiative privée.

C'est en Allemagne, sous la direction de la Commission allemande de l'Avortement et de la Reichscentrale de Hanovre, que le travail le plus méthodique de prévention de l'avortement épizootique a été effectué. La prophylaxie est basée sur l'emploi de mesures hygiéniques dans les exploitations peu infectées et sur l'emploi de vaccinations par vaccins vivants dans les étables très infectées.

Le plan de la lutte et les méthodes suivies ont été exposées dans les Directives de la Commission allemande de l'Avortement, dans les Nouvelles Directives, et dans le bulletin de l'Office International des Epizooties qui fonctionne à Paris sous l'égide de la Société des Nations. Les mesures systématiques comprennent: l'examen préliminaire de l'effectif, des mesures pour supprimer la maladie dans les exploitations faiblement infectées, des

mesures pour supprimer la maladie dans les exploitations moyennement et très infectées (vaccination, mesures d'hygiène) et enfin des mesures de prophylaxie contre la propagation de la maladie.

L'examen préliminaire de l'effectif

Un troupeau est considéré comme suspect s'il est survenu des avortements et si l'on y observe fréquemment des rétentions du placenta, des vaches nymphomanes ou stériles. L'examen *bactériologique* décide de la nature exacte de ces accidents et la Commission conseille d'expédier à un Institut vétérinaire voisin (les délais de transport condamnent la centralisation des diagnostics). 1o Un fétus, ou encore le coeur ou l'estomac d'un fétus. 2o Une partie du placenta, de préférence la partie altérée. 3o Des échantillons du sang des animaux qui ont avorté et des échantillons prélevés chez tous les reproducteurs de l'étable.

Si l'examen bactériologique montre que les accidents sont dûs au Bacille de Bang et que les *symptômes* de la maladie n'existent que chez un petit nombre d'animaux, on préconisera des mesures d'hygiène, les animaux qui présentent une réaction d'agglutination positive étant isolés ou abattus. Si, au contraire, plus de 10% de l'effectif est infecté on utilisera la vaccination associée à des mesures d'hygiène.

La vaccination

Cette vaccination est effectuée à l'aide de cultures vivantes de Brucella Abortus injectées à 15 jours d'intervalle. Les vaches sont conduites au taureau dès l'apparition des premières chaleurs, mais l'on doit laisser un délai d'au moins 4 semaines entre la dernière vaccination et la saillie. Les femelles qui n'auraient pas été fécondées seront soumises au traitement de la stérilité.

Les génisses seront autant que possible isolées des vaches infectées, elles ne seront pas vaccinées avec des vaccins vivants. Si leur isolement n'est pas possible elles recevront du troisième mois de la gestation une double vaccination avec un vaccin tué.

Les taureaux ne doivent pas être vaccinés avec les cultures vivantes, de même les vaches dont le lait est destiné à être consommé cru (lait garanti ou certifié).

Nous ne reviendrons pas sur les mesures d'hygiène qui sont analogues à celles qui sont préconisées au Danemark.

Les résultats de cette pratique sont très encourageants. Proschold constate en Poméranie que pour l'année 1929-30 parmi 4200 animaux qui avant la vaccination avortaient dans la proportion de 30.2%, il ne se produisit que 3 % d'avortement en 12 mois. Schumann, de Breslau, donne les résultats d'une série de vaccinations comprenant 5,223 animaux (Cultures vivantes chez les vaches non gravides; cultures tuées chez les vaches gravides) les avortements s'élevèrent à 2.2% par an contre 22% avant al vaccination.

Zwick, dans la Deutsche Tierarztliche Wochenschrift, conclut que cette méthode, combinant l'emploi des vaccins vivants et tués et les méthodes usuelles de prophylaxie, est actuellement la plus efficace et la plus économi-

que qui soit à notre disposition et qu'elle ne présente pas de dangers spéciaux pour l'hygiène humaine comme certains auteurs se sont plus à le proclamer.

Ces résultats, de même que les expériences qui se poursuivent sous les auspices de l'U.S. Bureau of Animal Industry et celles de la Commission Britannique avec le vaccin fabriqué par le Laboratoire Impérial de Weybridge, doivent nous faire réfléchir quelque peu avant de condamner systématiquement l'usage des cultures vivantes pour la prophylaxie de l'avortement. Il semble qu'il entre davantage de préjugés que de certitude basée sur l'expérimentation dans ce refus d'essayer un excellent moyen de lutte contre une redoutable maladie.

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RESUME DES ARTICLES PUBLIES EN ANGLAIS DANS CE NUMERO

Resistance Comparee de Diverses Varietes de Ble a la Germination du Grain dans les Meulons. J. B. Harrington, Université de la Saskatchewan, Saskatoon, Sask.

En 1927 et en 1931 un temps humide ayant suivi la récolte l'auteur a pu prendre des échantillons comparables provenant d'une expérience à quadruples par celles faite avec 13 variétés de blé. Le blé Marquis a résisté à la germination treize fois aussi bien et le blé Reward neuf fois aussi bien que le blé Garnet.

Resultats d'une Experience de Sept ans sur l'Eclaircissement des Pruniers. George H. Dickson, Station Expérimentale Horticole de l'Ontario, Vineland, Ont.

1) Contrairement à l'attente de l'auteur, l'éclaircissement ne semble pas provoquer de fructification annuelle chez les prunes Domestica.

2) La récolte totale ne semble pas influencée par l'éclaircissement sauf dans les cas de perte de vitalité des arbres non éclaircis ayant produit trop de fruits, auquel cas les arbres sont généralement endommagés pendant l'hiver.

3) L'éclaircissement a augmenté la grosseur des fruits en leur donnant une valeur économique supérieure à celle des fruits provenant d'arbres non éclaircis.

4) L'éclaircissement aide au contrôle de la pourriture brune.

5) Les fortes récoltes délaient la maturité aussi bien que la floraison.

Heredite du Facteur de Croissance chez les Volailles Domestiques. M. Lerner et V. S. Asmundson, Université de la Colombie Britannique, Vancouver, B.C.

(1 Les auteurs discutent diverses formules représentant le facteur de croissance et donnent leurs raisons pour adopter la formule

$$R = \frac{(W_2 - W_1)\ 100}{\frac{1}{2}\ (W_2 - W_1)}$$

pour cette étude.

2) Les auteurs présentent des chiffres concernant le facteur de croissance des variétés Light Sussex et Ancona et leurs hybrides.

3) Les auteurs démontrent la possibilité de réduire les facteurs de croissance à des chiffres arbitraires par l'emploi de formules convenables.

4) Les chiffres indiquent une différence fondamentale dans le facteur de croissance entre les deux races utilisées. Ils indiquent aussi un mode complexe d'hérédité du facteur de croissance.

5) Les auteurs font aussi ressortir des différences génétiques dans le poids et la longeur du tarse-méta-tarse à l'âge de 12 semaines.

6) Il existe une corrélation étroite entre le poids et la longeur du tarse-méta-tarse à l'âge de 12 semaines, indépendante du facteur de croissance pour la période 8ème à 12ème semaine.

La Parthenocarpie dans les Concombres. W. J. Strong, Station Expérimentale Horticole, Vineland, Ont.

La parthénocarpie ou production de fruit sans pollinisation est très importante pour le producteur de concombres sous verre. Une variété capable de former des fruits abondamment sans pollinisation tout en ayant d'autres caractères désirables aurait une valeur considérable, beaucoup de travail et de temps étant requis par la pollinisation artificielle. De nombreux essais ont été faits par les sélectionneurs pour obtenir une telle variété. Certains résultats ont été obtenus mais il semble que pour arriver à un succès définitif il soit nécessaire de prendre en considération non seulement le travail de sélection à proprement parler mais aussi les causes de la parthénocarpie et les possibilités de les contrôler.

CURRENT PUBLICATIONS

83. The Cost of Living in the United States, 1914-1930. National Industrial Conference Board, 247 Park Ave., New York, 1931.

This is the sixth study of the cost of living in the United States or various parts of the country contributed by the Board. The introduction to the current offering deals at some length with the importance of such information in a complex economic society. The book is divided into five chapters, the first dealing at length with a variety of considerations necessary to the task of computing such an index; the second with the reasons for the adoption of 1923 as the base period instead of 1914 which has previously been used; the third deals with the details of computation; the fourth discusses the changes that have occurred since 1914 and the fifth deals with conclusions.

Statistical data and charts make up a large part of this report as might be expected. Particularly interesting are two charts (numbers 4 and 5) which indicate the trend of prices since 1914 of the major items comprising a family budget. One is struck with the differences in rates of increase of the principle groups of items during the period from 1914 to 1920. Food prices (largely farm products) advanced most rapidly, and recalling that various authorities have shown that a similar movement characterized other periods of inflation one is naturally impelled to ask if this will be the case during the next upward swing of prices and if farmers may expect to benefit accordingly. These charts also emphasize the wide discrepancy that prevailed in 1919-20 and the relative uniformity of movement since that time.

It is noted (P.75) that the decline in the cost of living in the United States during 1930 compared with 1929, was only 3.8 per cent which was, as pointed out by the Board, less than is commonly thought to have been the case. The costs in 1925 and 1926 were the highest of any period since the war. -J. F. Booth.

84. The Pathology of Reproduction in Perspective. W. L. Williams, in Veterinary Medicine, Chicago, July 1932. Available from Dept. of Agr. Library, Ottawa.

"The veterinary profession and the dairy husbandman keep up such a loud and ceaseless din over *contagious abortion,* that nothing can be heard concerning the basic principles of physiological reproduction". But that does not prevent Dr. Williams from dealing with these principles in such a masterly way that, despite the din, he compels attentive listening.

"It has been aimed to bring out in bold relief the indescribable confusion commonly existing in the pathology of reproduction. Bang's bacillus in common with other contagions, —sterility, abortion, dystochia, monsters, premature birth and prolonged gestation, retained afterbirth, are all alike governed by fixed laws. The need of today is to learn and comprehend those laws".

For at least a quarter century and in the largest clinic of its kind, Professor Williams has been almost exclusively studying material which illustrated the results of transgressing these laws. He has been doing so in his own sane and practical way regardless of current theory. The product is an experience without counterpart, an accumulation of data which is overwhelming. But the author is no dry statistician: his observations are spiced with humour. He marshalls his statements clearly and in such a way that the facts speak with an air of finality. Yet he neither preaches nor argues.

This contribution is the substance of a series of lectures given at the Alabama Polytechnic Institute last spring. The title is accurate but the article cannot be reviewed because it fills the entire issue. It should be in the hands of enlightened breeders the world over that they may read, mark, learn and inwardly digest it and finally, put it into practice. Only by so doing can they hope to escape fully, the truth of a remark once made by Bateson, "Breeding is the greatest industry to which science has never yet been applied".

—Alfred Savage.

85. Progress and Problems of the Dairy Industry in Canada. J. E. Lattimer, Macdonald College, McGill University. Technical Bulletin No. 10.

Dr. Lattimer presents a concise survey of the development and problems of the dairy industry. The consumption of dairy products has increased in Canada from approximately $42,000,000 in 1900 to over $266,000,000 in 1930. This rapid expansion in consumption, due largely to improved quality, has been accompanied by a large expansion in production, although the ratio of cows to people has remained approximately the same since 1871. This ratio of one cow to every three people would indicate that we are apt to have a surplus of dairy products for some time, especially if any considerable improvement is made in methods of production. The handling of this surplus presents one of the difficult problems of marketing. At the present time this problem is critical owing to the general low price scale prevailing. This is particularly true in connection with the fluid milk market. Reorganization in the methods of disposal of surplus fluid milk is necessary and the possibility of retaining it at country points and processing it rather than shipping it to the city to be made into butter is suggested. Strong evidence is given for continuing educational work on herd improvement, as the record of progress along this line over a period of years leaves much to be desired. The expansion of the export and domestic markets should be more thoroughly organized as there appears to be room for expansion even though a considerable increase in consumption per capita has taken place in the past decade. The whole bulletin is packed with reliable statistics interpreted in Dr. Lattimer's usual good common sense way, and is a credit to the economic literature of the country. —H.L.T.

86. The Determination of Moisture in Honey. H. D. Chataway, Junior Research Chemist, National Research Laboratories, Ottawa. Canadian Journal of Research, Volume 6, May, 1932.

The relationships between refractive index and moisture content of honey and between viscosity and moisture content have been quantitatively investigated, and as a result it has been found possible to utilize each of these properties for the determination of the moisture content. The requisite tables have been drawn up and details of the methods given. The degree of accuracy attainable is equal to that of the standard A.O.A.C. method, while the procedure is in both cases simpler and more rapid.

87. What the Country Women of the World are Doing. Published by the Liaison Committee of Rural Women's and Home Makers Organizations, London, England.

Three volumes of this publication dated 1930, 1931 and 1932 are available from the Department of Agriculture Library, Ottawa. They give an account of the work carried on by a committee formed under the auspices of the International Council of Women held at Geneva in 1927. A representative committee of rural women's organizations was formed in 1929 and has published a volume giving accounts of women's work in different countries each year since. The majority of the articles appear in English. To attempt to give any idea of the material contained is impossible in a short review. One gathers the impression, however, that the Women's Institute and similar organizations in other countries find here an opportunity for exchanging ideas and even exchanging products of their own handiwork. Canadian workers are well represented by reports and special articles.

88. Analysis of Income of Apple Growers in 1929-30. The Economic Annalist, Volume 2, No. 5. Published by the Agricultural Economics Branch, Dominion Department of Agriculture, Ottawa.

A labour income analysis of Nova Scotia, Quebec and Ontario apple districts is reported in this article. It will be remembered that this was a poor year for the apple growers and one would not expect large labour incomes. One is rather surprised, however, to find that in Nova Scotia the average labour income was minus $484, in Quebec minus $22, and in Ontario plus $161. The plus income in Ontario is accounted for by the fact that the farmers received larger incomes from supplementary lines such as dairy cows, canning crops and fresh vegetables. While this analysis covers only one year, and a bad year at that, it is significant that all three areas showed an unprofitable business when all factors were taken into consideration. It is worth noting that in each area there were, however, farms

on which profitable labour incomes were made. There always appear to be men who are able to organize their business on a profitable basis, even though conditions are unsatisfactory.

This article presents the first study made of these three sections with all figures reduced to a comparable basis, although previous studies have been made in Ontario and Nova Scotia. The statistics are well presented allowing one to easily grasp several aspects of the situation. Further studies now under way are preserving the continuity of this work, and exceedingly valuable analyses will be available from year to year. —H.L.T.

89. Feeding Farm Animals. Written and compiled by Hon. Duncan Marshall. Published by the Imperial Oil Company.

This is the fourth of a series of farm books published by the Imperial Oil Company. In them an effort has been made to put in book form many of the practical methods of successful farmers throughout Canada. Much additional material is based on experimental work done by various institutions and an effort has been made to present it in such a form that it will be easily understood by the average farmer. The books have been so popular that over 70,000 copies of each have been mailed on request. One might paraphrase a popular slang expression and say that "70,000 farmers can't be wrong" in their demand for these books. They evidently meet a popular desire.

The recent volume on Feeding Farm Animals gives a great deal of practical advice on the feeding and care of horses, cattle, sheep and swine. It would not be possible, of course, to give, in a pocket size volume of 300 pages, a summary of all the work and advice that is available on this subject. There has been given, however, a compendium of good sound advice, which, if followed by the majority of the farmers who will secure the book, will undoubtedly be of great benefit to the men themselves and to the live stock industry generally. Mr. Marshall's recommendation that breeding sires in beef cattle should be selected on the basis of slaughter tests of their progeny as well as by show ring standards is a point which should be applied to other classes of stock wherever it is possible to measure performance by the first individuals sired. As usual the illustrations are good and the text written in a manner which will hold the interest of the reader. —H.L.T.

90. The Effect of Cooked Potato in Conjunction with Fermentable Carbohydrate in Breadmaking. R. H. Harris, Chemist, Quaker Oats Company, Saskatoon. Published in the May 1932 issue of the Canadian Journal of Research, Volume 6, Number 5.

A series of eleven flours of different types and baking strengths were baked by a variety of methods in order to determine the effect of adding fermentable sugar to the dough in conjunction with cooked white and sweet potato. Preliminary bakings using a simple formula of flour, water, yeast, and salt, with and without sucrose, indicated the value of sucrose in flours of low diastatic power.

The addition of cooked white potato in the absence of sucrose gave still poorer results with these low diastatic flours, but improved the better flours. The addition of sucrose increased the response of all flours, the maximum stimulation being obtained when both malt and sucrose were added. Evidently, cooked white potato is not a satisfactory substitute for fermentable sugars.

It was found that cooked sweet potato not only supported yeast activity, but also stimulated it. However, it also imparted a deleterious dark tint to the loaf, thus lowering the color score.

The addition of potassium bromate without sucrose resulted in a greater loaf volume than that obtained by the use of simple formula with sucrose, except in the case of two flours, particularly low in diastatic activity. The inclusion of diastatic malt increased the loaf volumes of these two flours.

No significant relationship was found between protein content and loaf volume, in the absence of added fermentable carbohydrate. The addition of sucrose and malt to bakings with potato extract resulted in correlations equal to those obtained with other flour improvers.

CONCERNING THE C.S.T.A.

THE WINNIPEG CONVENTION

Whatever misgivings there may have been regarding the success of the twelfth annual convention of the C.S.T.A. were quickly dispelled on the opening day. While the attendance was not expected to be large, there was a good crowd on hand for the opening session, and registrations by the second day had reached a total of 175, equalling the largest C.S.T.A. convention previously held in the west, that at Winnipeg in 1929. It was said that the attendance at lectures and meetings was even larger than at the previous convention. The programme was not allowed to lag and all lectures and items of business went through on scheduled time. Owing to the unavoidable absence of the President, Mr. H. S. Arkell, and both Vice-Presidents, Dr. G. I. Christie, and Hon. Dr. A. Godbout, Mr. L. H. Newman, Honorary Secretary and Vice-President elect, opened the convention. The Presidential Address and Report of the General Secretary were read, and several convention committees were appointed. Two addresses were presented in the first morning session; first, "What has the Engineer for Agriculture?", by Prof. L. J. Fletcher, President of the American Society of Agricultural Engineers, and second, "A Project in the Use of Group Consciousness as a Lever in Agricultural Progress, by Robert England, Western Manager, Departments of Colonization and Agriculture, Canadian National Railways, Winnipeg. Both these addresses were interesting and well presented and held the attention of the convention. The address by Professor Fletcher, the only speaker from outside of Canada to appear on the general programme, was made possible through the courtesy of the Manitoba branch of the C.S.T.A. which undertook to secure Professor Fletcher This address will be found elsewhere in this issue of *Scientific Agriculture*.

The second day of the convention featured the Report of the Special Committee on Functions of the C.S.T.A., the Report of the Committee on Research and the Report of Convention Committees, all of which will be presented in the August issue of *Scientific Agriculture*. There was keen discussion on the material contained in these reports and members felt that a good day's work had been done. A feature of the morning programme was an address on "Recent Developments in Cereal Chemistry", by Dr. W. F. Geddes, Professor of Agricultural Chemistry, University of Manitoba, Winnipeg. This address will also appear in a later issue.

The afternoon session was devoted to research, the discussion being guided by the report of the Research Committee presented by Mr. M. B. Davis in the absence of the Chairman, Dr. W. F. Brittain. Following discussion on this report, Dr. R. C. Wallace, President of the University of Alberta, gave a very fine address on "Research Today." A summary of this address is included in this issue of *Scientific Agriculture*. Following Dr. Wallace, the Dominion Minister of Agriculture, the Honourable Robert Weir, complimented the members of the Society on their very evident desire, as expressed individually and through the activities of their Society, to coördinate their work throughout the various provinces and institutions. The Minister reported on the success of several provincial committees which at the present time were functioning between his Department and Provincial Departments and stated that he felt a need for a National Committee to advise him on matters of administration which concerned the services of his Department and the Departments and Institutions of several provinces. He requested that the C.S.T.A.advise him concerning the possibility of setting up such a committee composed of the men who are actively engaged in the agricultural services of the country. The Minister was warmly received and expressed his appreciation for the opportunity of coming into closer contact with members of the Society.

In the evening those at the convention were the guests of the Manitoba branch of the C.S.T.A. at a banquet held in the dining hall of the residence. Honourable John Bracken, who at that time was just receiving congratulations on his re-election as Premier of the Province of Manitoba, was a guest at the banquet and spoke briefly. Following the banquet the convention adjourned to the lecture hall where an address on "Canada in World Markets" was given by Dr. J. W. Dafoe, Editor of the Winnipeg Free Press. A summary of this address will appear in a later issue. The remainder of the evening was spent in dancing.

Group sessions of the various affiliated Societies and groups were held on Wednesday and Thursday. The Canadian Society of Agricultural Economics and the Western Canadian Soc-

iety of Agronomy both reported well attended and very interesting sessions. The Soils Group, meeting for the second time, effected its permanent organization and had a very profitable session. The Horticultural Group carried on its usual good work and was assisted by the Manitoba Horticultural Association. The Agricultural Engineers held their initial session and made arrangements for the permanent organization of their group in Canada. Their sessions were assisted and the general interest in their work aroused by the presence of Professor L. J. Fletcher, President of the American Society of Agricultural Engineers. While some fear was expressed that the group sessions might be small, the attendance in mose cases was larger than expected and the interest and enthusiasm were strong.

The social side of the convention, while not occupying as prominent a part as at some recent conventions, was not overlooked and it was felt that we had a very happy combination of business and pleasure. The Southwood Golf Course adjoining the College was well patronized and a large supply of golf balls distributed in the rough for the future profit of the caddies of the course. The ladies were entertained extensively with trips to points of interest in the city and adjacent districts, with an afternoon tea at Government House and Lower Fort Garry and luncheon at the Hudson Bay Company's Store. The thanks of the ladies for the entertainment received was very ably expressed by Mrs. O. S. Aamodt. Members of the C.S.T.A. were guests at the C.S.G.A. banquet, entertainment, and dance on Wednesday evening. One of the most enjoyable features of the week's programme was the excellent musical entertainment provided under the direction of Mrs. C. H. Goulden. Several of the leading younger artists of Winnipeg delighted the gathering with their songs and dances. It was of special interest to the members of the C.S.T.A. to enjoy the fine artistic ability of members of the Society. In addition to the beautiful violin selections by Mrs. Goulden we were treated to very pleasing vocal numbers by Dr. K. W. Neatby of the Dominion Rust Research Laboratory, Winnipeg, and Mr. Kenneth M. King of the Dominion Entomological Laboratory, Saskatoon.

The work of the Manitoba convention committee was excellent and left nothing to be desired in the way of comfort and entertainment for the guests. Everyone felt that although the convention had been short the time had been exceedingly well and happily spent. The Society can feel that, with three conventions to the credit of the Winnipeg members, an invitation in the future to hold a convention at that point is a guarantee of its success regardless of what conditions may prevail. With the Winnipeg branch behind a convention it simply has to be a success.

CAANADIAN SEED GROWERS' ASSOCIATION ANNUAL CONVENTION

With an attendance well over the average and an increasing interest and enthusiasm in the activities of the Association, the annual convention of the Canadian Seed Growers' Association, held at the Manitoba Agricultural College June 13 to 15, 1932, was generally conceded to have been a very profitable gathering from the standpoint of the delegates assembled. During the time between the cordial addresses of welcome to the College extended by Dean W. C. McKillican and Mr. J. H. Evans on Monday morning and the pronouncement of adjournment by President T. J. Harrison on Wednesday afternoon, a great deal of valuable additions to policy were made, the fruits of which it is hoped will benefit the growers and users of registered seed in the years to come.

The delegates adopted many recommendations made by the Cereal, Horticultural and Forage Crops sections of the Plant Breeders' Committee. The following varieties of crops not already on the list were accepted as eligible for registration purposes: *Oats*: Cartier and Gopher. *Barley*: Colsess and Regal. *Peas*: Chancellor and Early Blue. *Beans*: Norwegian Brown. *Western Rye Grass*: Mecca. *Crested Wheat Grass*: Fairway. *Corn*: Lethbridge Strain of Northwestern Dent, Maple Creek Strain of Dakota White Flint, Colquhoun's Strain of White Capped Yellow Dent, Manalta Strain of Yellow Flint and Maple Creek Strain of Gehu.

The Association paid a tribute to the outstanding work done in the cause of registered crops by Mr. J. G. Raynor, District Seed Inspector of the Dominion Seed Branch, Ottawa, Ont., and Frederick Kirkham, Saltcoats, Sask., by electing them Robertson Associates. This class of preferred membership was established some time ago to honour those members who have rendered valuable service to agriculture in Canada through their efforts in the promotion of improved grain crops .

Mr. A. L. Searle, President of the Searle Grain Co., Ltd., Winnipeg, Man., was elected an Honorary Member of the Association. Mr. Searle is the first to receive this honour.

The slate of officers for 1932-33 is the same as last year, namely: *Honorary President,* George H. Clark, Dominion Seed Commissioner; *Honorary Vice Presidents,* C. A. Zavitz, Ilderton, Ont., H. G. L. Strange, The Searle Grain Co., Ltd., Winnipeg, Man., and L. H. Newman, Dominion Cerealist; *President,* T. J. Harrison, Dominion Board of Grain Commissioners, Winnipeg, Man., *Vice President,* R. Summerby, Macdonald College, P.Q., *Secretary-Treasurer,* W. T. G. Wiener, Jackson Building, Ottawa, Ont. Nineteen directors were also elected for the ensuing year and these comprise representatives from every province in the Dominion.

A very impressive feature of the proceedings was the unveiling of a massive cairn erected on the spot where the first shipment of what from western Canada was loaded on a Red River steamer. His Grace Archibishop Matheson pronounced the dedication and Miss E. Cora Hind unveiled the memorial. Following this ceremony a picturesque pageant was staged at the dock from which the first shipment of wheat was made and a cargo of wheat was loaded on a barge amidst the sounding of whistles from nearby tugs. With an answering cheer the whole company comprising a representative group of the present day Canadian Seed Growers' Association embarked and the barge slowly proceeded up-stream on the same course taken by the steamer "Selkirk" in 1876.

That same evening at the College a banquet very fittingly wound up the series of meetings which had met under such pleasant conditions. At this event recognition was given to the work of a number of pioneers in agriculture in western Canada. By these memorials the seed growers of today might quite justly feel that they are paying homage to the men and women to whose faithful work and stoic endurance of hardships we owe the foundation upon which the agricultural structure of western Canada now rests.

NATIONAL RESEARCH COUNCIL

ADVISORY COMMITTEE ON AGRICULTURAL RESEARCH

On June 9th the initial meeting of the Advisory Committee on Agricultural Research of the National Research Council was held in the National Research Laboratories, Ottawa. The establishment of this committee has been authorized by the Committee of the Privy Council on Scientific and Industrial Research. While much good work has been accomplished by the Associate Committees of the National Research Council working on specific problems, the need has been felt for a general committee to advise on general problems and suggest special lines of research to be undertaken by the Council. The Advisory Committee is to consist at present of the Deans of the Agricultural Colleges throughout Canada, three representatives of the Dominion Department of Agriculture and the Chairman of the Research Committee of the C.S.T.A. The next session will be held in Toronto at the time of the Royal Winter Fair when details of further research projects and the scope of the committee will be discussed.

An outline of work conducted to date was presented at the recent meeting, together with a tentative outline of new work. Studies to be undertaken by the Division of Biology and Agriculture in the new laboratories are to be generally fundamental in character, although special researches in any field of agriculture may be undertaken upon representations as to their necessity by the Advisory Committee or another qualified body. Assistance will be rendered to other institutions: (a) by providing laboratory facilities and technical advice to workers who wish to pursue their problems for a time at Ottawa; (b) by carrying out special investigations, or parts of investigations, on request; (c) by maintaining a statistical section available for consultation in regard to the planning of experiments and the methods of analysing results. In connection with the organization of the Council's Laboratories it was announced that a Division of Research Information has been developed which is staffed by experts in biology as well as in other sciences, and access is had to the research results of almost the entire world. Translations from French, German, Italian, Dutch, Spanish and Russian will now be available.

AGRICULTURE READY FOR THE IMPERIAL CONFERENCE

During the past two months officials of the Dominion Department of Agriculture and representatives of the producers and distributors organizations throughout Canada have been busily engaged in preparing the case for agriculture for the Imperial Conference. The large amount of information already on hand by the various departments and organizations has been collated and summarized, and briefs have been prepared dealing with many phases of the industry and with intra-Imperial trade in general. Technical committees have prepared information from the government standpoint, while farmers' organizations of national and provincial scope interested in the export business have submitted briefs prepared from the farmers viewpoint. Interlocking committees have checked the information and recommendations from these two sources with the result that there is a remarkable degree of unanimity in the material prepared for the Conference. Abstracts of factors affecting the trade in approximately 150 agricultural products have been prepared and forwarded to the government. It is now generally understood that the case for agriculture has been prepared in excellent form, and there have been some comments around the Capital to the effect that agriculture is now prepared to speak with a more nearly unanimous voice than is industry.

The general set-up for agricultural representation to the Conference consists of a General Agricultural Committee headed by the Honourable Robert Weir, Minister of Agriculture. Dr. E. S. Archibald, Director of Experimental Farms, is Assistant Chairman and Mr. P. E. Light of the Markets Intelligence Service of the Dominion Live Stock Branch is Secretary. Representatives of departments and organizations are as follows:

Geo. B. Rothwell, Live Stock Commissioner.

S. E. Todd, Secretary of the Industrial and Development Council of Canadian Meat Packers Limited.

W. A. Brown, Poultry Division, Dominion Department of Agriculture.

H. B. Clemes, United Farmers Cooperative, Toronto.

J. F. Singleton, Dairy Commissioner.

F. E. M. Robinson, President, National Dairy Council.

G. H. Clark, Dominion Seed Commissioner.

E. F. Crossland, Canadian Seed Trade Association, Toronto.

J. F. Booth, Commissioner, Agricultural Economics Branch.

L. F. Burrows, Secretary, National Horticultural Council,

G. E. McIntosh, Fruit Commissioner.

The above members of the general committee have directed the activities of the various sub-committees. The recommendations of the General Agricultural Committee are carried to the government by the Assistant Chairman, Dr. E. S. Archibald, who is a member of the Tariff Preparatory Committee, a small select committee of internationally known government officials and economists who advise the cabinet directly.

Information on each phase of the agricultural industry affected by the Conference has been prepared in considerable detail under the following heads:

(a) *Scope and Importance of the Industry to Canada,* including the volume of production, volume of exports and imports, Canada vs. other Empire countries, number of persons interested in the industry, etc.;

(b) *Production;* including trends, factors limiting production, potential production, costs of production in Canada vs. other countries, and special qualities which make the commodities suitable for the United Kingdom markets;

(c) *Marketing;* including descriptions of methods and agencies, prices, storage facilities and holdings, grades and standards, packages, shipping seasons and other similar points;

(d) *Transportation;* including freight and ocean rates, improvements and additions needed, etc.

(e) *Embargoes, Tariffs, Customs Formalities and Other Restrictions on Trade;* including those prevailing against Canadian products, those maintained by Canada against other products, products on which tariff concessions in the United Kingdom would be most beneficial, estimate of tariff preference, quota, etc., necessary for Canadian products to secure a fair share of United Kingdom markets;

(f) *General;* including suggestions for improving sale methods, suggestions on how Canadian farmers might purchase Empire products, improvement in Statistics, and suggestions on improved standards of grading and marketing products.

From the above items, which do not by any means include all that the briefs cover, it may be seen that a vast amount of ground has been covered in order to enable the Dominion Government to negotiate on behalf of Canadian agriculture during the Conference and in the succeeding months. It is doubtful if as thorough a survey has ever been prepared previously for any of the products covered by these briefs. The information obtained will not only be useful for the Conference, but for the coördination of agricultural policies throughout Canada.

NOTICE TO C.S.T.A. MEMBERS

It is hoped that all members of the Society will take time to read the two general articles by President R. C. Wallace of the University of Alberta, and Professor L. J. Fletcher, President of the American Society of Agricultural Engineers, and also the several news items in this section of the magazine. Throughout the new volume more space will be given to news, and there will also be shorter articles and greater variety of articles. The Winnipeg Convention put a limit of twelve pages on articles, although additional pages may be used if the author can arrange for the payment of part of their cost. There is a large supply of good material on hand. Dr. J. W. Dafoe, the internationally known Editor of the Winnipeg Free Press, will have a short article on the Imperial Conference in the August issue. There will also be a thought-provoking article by Professor Drummond of the University of Toronto on the efficacy of cutting costs of production as a remedy for the present situation.

NOTES AND NEWS

W. J. Black, (Toronto '02) Director, Departments of Colonization and Agriculture, Canadian National Railways, Montreal, was granted the honorary degree of LL.D. at the recent convocation of the University of Manitoba. Dr. Black became President of the Manitoba Agricultural College in 1905 remaining with that institution until he became Federal Commissioner under the Agricultural Instruction Act in 1916. He was Chairman of the Soldier Settlement Board of Canada from 1918-20 and Dominion Deputy Minister of Immigration and Colonization from 1921-23.

E. C. Hallman, (Toronto '02) Farm Manager, Oliver Government Farm, North Edmonton, has changed his address to 9923-106th Street, Edmonton, Alta.

H. L. Steves, (British Columbia '24) Fieldman for the Holstein-Friesian Association of Canada, will be located at Red Deer, Alberta, until next December.

F. L. Drayton (McGill '14) has been awarded his doctor's degree at Cornell and has received a United States Research Council Fellowship for a year at Harvard. His address is Biological Laboratories, Harvard University, Divinity Avenue, Cambridge, Mass.

R. E. English (Alberta '28) is now located at the Field Crops Branch, Department of Agriculture, Edmonton, Alta.

R. G. Emslie (Toronto '28) has changed his address to 313 Clifton Road Woodside, Aberdeen, Scotland.

W. V. Longley (Toronto '11) Director of Extension and Professor of Agricultural Economics, Nova Scotia Agricultural College, Truro, is confined to his home for a few months following an attack of pleurisy. Dr. Longley reports that he is taking a good rest and can see a considerable improvement already.

Eric Boulden (McGill '18) District Agriculturist, Department of Agriculture, Windsor, N.S., has been transferred to Truro, as Acting Director of Extension during the illness of Dr. W. V. Longley.

E. Boudreau, (Laval '31) is now stationed at Roberval, Lake St. John, as Federal Live Stock Promoter.

John F. Allan, (Saskatchewan '31) has resumed his position as District Representative in the Saskatchewan Department of Agriculture located at Tisdale, Sask.

H. W. E. Larson, (Oregon '28) has changed his address to New Soils Building, University of Wisconsin, Madison, Wis.

Jean Hardy, (Montreal '31) Assistant Agronome at Rouville, has been transferred to the position of Assistant Agronome, St. Jerome, Terrebonne County, P.Q.

F. X. Gosselin, (Laval '23) was married on July 2nd to Miss Agnes Hérard of Ramore, Ont. On their return from their wedding trip they will take up residence at the Experimental Station, Kapuskasing, Ont.

R. M. Lewis, (Toronto '31) who has been pursuing graduate studies at Cornell University has returned to Guelph where he is located at 45 King Street.

H. B. Sommerfeld, (Saskatchewan '21) recently of the University of Manitoba, now farm Manager for the Colonization Finance Corporation of Canada Limited at Yorkton, Sask., had conferred upon him the degree of Doctor of Philosophy by the University of Minnesota at the recent convocation held at that Institution on June 6th. Doctor Sommerfeld took his major in Animal Husbandry and his minor in the field of Agricultural Economics and Farm Management. His thesis involves a study of the production and utilization of horse power in Manitoba. His is the first degree of this kind to be conferred in the field of Animal Husbandry by the University of Minnesota.

W. S. Chepil, (Saskatchewan '30) of Edwin, Manitoba, was married on June 19th to Miss Jeanne Edythe Sunko, daughter of Mr. and Mrs. Andrew Sunko, 1872 Broder Street, Saskatoon, Sask.

W. C. Broadfoot, (Minnesota '24) Plant Pathologist, Dominion Laboratory of Plant Pathology, University of Alberta, Edmonton, was granted the degree of Doctor of Philosophy at the June convocation of the University of Minnesota. The subject of his thesis was "Studies on Foot and Root Rot of Wheat in Western Canada."

George M .Tait (McGill '28), formerly lecturer in Horticulture at Macdonald College and for the past two years pursuing graduate work in the Department of Vegetable Crops at Cornell University, has received the appointment of Crops Specialist with the Canadian Seed Growers' Association with headquarters at Ottawa. Mr. Tait will have charge of the Forage and Garden Vegetable Crops work at present under development by the Association and will take up his new duties on July 1st, 1932. He has just been awarded the degree of M.S. by Cornell University, having majored in vegetable crops.

J. F. Singleton, Chief of the Division of Dairy Markets and Cold Storage, Dominion Department of Agriculture, has been appointed Dairy and Cold Storage Commissioner for the Dominion of Canada, the appointment to take effect upon the retirement of Dr. J. A. Ruddick in September. Mr. Singleton was Dairy Instructor in the Ontario Department of Agriculture from 1903-06 and Assistant Chief Dairy Instructor for Eastern Ontario from 1909-13. He was Chief Inspector of Dairy Products, Dominion Dairy and Cold Storage Branch from 1914-19, becoming Chief of the Division of Dairy Markets and Cold Storage in 1920. Mr. Singleton brings to this important position long experience in administration and a sound practical knowledge of the Dairy Industry.

Gertrude Russell, (McGill '26) has changed her address to Canadian National Steamships, Montreal, P.Q.

J. D. Newton, (McGill, '17) Associate Professor of Soils in the University of Alberta, has been given one of the three Carnegie Corporation grants at the disposal of the Universities' Bureau of the Empire for this year. These grants are awarded to members of university staffs of overseas universities to visit Great Britain for such research or special investigation as may approve itself to the executive committees of the bureau. Dr. Newton will leave in September to work for a year in the Rothamsted Station in England, of which Sir John Russell is the director, on research connected with the bacteriological conditions and actions of soils. He has been concerned for some time in the course of his field work on Alberta soils with phases of this problem and will have the opportunity to carry on his research in one of the outstanding soil institutions of the world.